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ing Engineer

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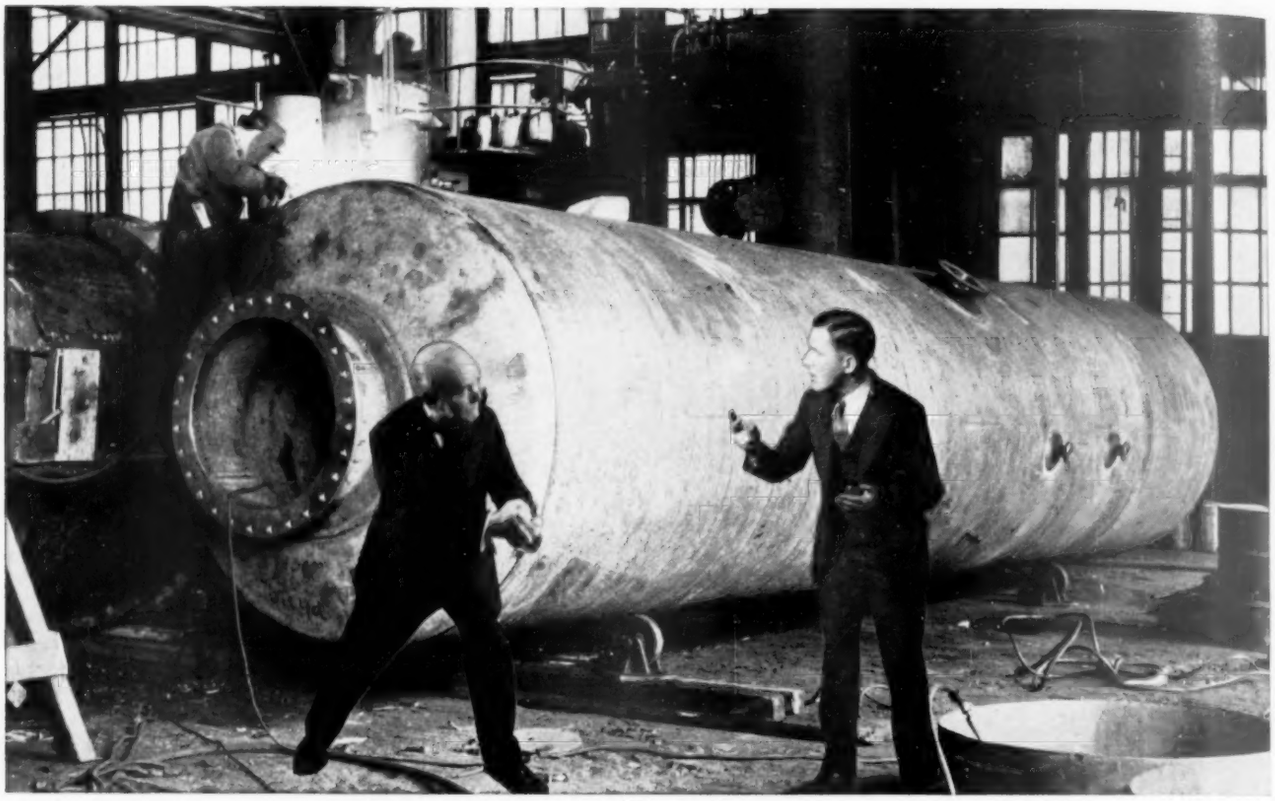
echnical Journal of the Welding Industry

Stainless-Clad Steel ith Welded Joints rm the Shell of is Centrifugal En- inment Separator d Catchall, and lid Stainless Is Used r the Inner Liner d Helical Element

(See Page 15)

December-1933

WELDING OF STAINLESS STEEL ATTRACTS POP AND LAD



"This, Lad, to my knowledge is the first large pressure vessel of arc-welded stainless steel construction. There's 20 tons of 18-8 stainless and about 1000 feet of welding in this job. The vessel is 59 feet 6 inches long, 6 feet 6 inches in diameter, with shell of ⅜-inch plate.

"To my mind, its construction is a tribute to the progressiveness and engineering skill of the Foster Wheeler Corporation who are building it."

"You're right, Pop, and it's also a tribute to the shielded arc process of welding which made possible welds having the same physical characteristics as the 18-8 stainless.

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THE WELDING ENGINEER

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DECEMBER, 1933

Vol. 18, No. 12

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· E D I T O R I A L ·

Santa Claus and the CWA

What has become of "the depression"? Those who are thronging the department stores and shops during the pre-Christmas week never utter the word. And the immensity of the crowds leads one to believe that every Tom, Dick and Harry, and their sisters, wives and children are there buying something for members of the family or a distant relation or friend. A spirit of festivity is apparent, the like of which has not been noticed for many years. ¶ The CWA program came at the right time to swell the volume of Christmas trade. Santa Claus would have been a pretty busy chap this year, even without the CWA. With the civil works program, however, the Christmas stockings will be bulging out with tokens of good wishes. The CWA has been successful in stimulating trade. That is because it is being launched during a period characterized by a general feeling of confidence and hope for the future. The recipients of CWA money, which is the first income many of them have earned in several years, are again able to find real enjoyment in many of the common things of life and in a few of its luxuries. A marvelous change has been wrought in their spirit. They are filled with hope for the future. That is why they are spending this money, and if it were not spent the CWA program would be a failure. ¶ On the other hand, the man who has had a steady income throughout these past years is still inclined to be cautious. Some of his kind are still banking in the old sock or the mattress. Though they might not know it, they are the ones who, by retarding recovery, brought about the NRA, AAA, PWA, and CWA. They give more encouragement to the socialistic statesmen than all the writings of Karl Marx. They are responsible for putting the federal government into the recovery business. Garbed in the armor-plate of the federal constitution, where they know they are secure, they find delight in taking pot-shots at our elected officials in Washington, who are honestly trying to formulate an honorable program for resuscitating trade. If the recovery program pinches these tight-wads, they will find no sympathy except among the few (though powerful) of their kind. ¶ Recovery and confidence go hand-in-hand. Any recovery program will be successful only to the degree that it inspires confidence. While it is a distressing fact that all CWA money must finally be translated into increased taxes, this apparently has not adversely affected the revival of confidence that has been evident since last March. ¶ CWA expenses constitute one of the items in the President's emergency budget. Some of these days that emergency budget must be reduced and tapered off to the vanishing point, and at that time will come the crucial test of the CWA program. As CWA spending is reduced, a normal increase in trade must make up the loss, if the program is to be successful.

Preaching the Message of Safety

It was only after very serious thought and consideration of all angles involved that we printed the story of the two explosions which snuffed out the lives of two welders, as reported in the October issue, on page 32. Our aim was not to compete with the daily newspaper, but to bring to the attention of welders and those in charge of welding operations, in an effective manner, the fact that there is a very grave danger in welding or cutting containers that have contained combustible fluids and have not been properly prepared for welding or flame-cutting. ¶ For many years the manufacturers of equipment and gases have been augmenting our own feeble efforts to get home the fact that if certain precautions are not taken certain accidents might happen. A common reply to such warnings is, "I welded one yesterday and nothing happened." So did the welder in one of the accidents reported, except that the next day something did happen—a tank exploded and killed him. ¶ The fellow who sneers at such warnings doesn't realize that he's lucky to be among the living whom we can continue to preach at until they meet the unlucky day. ¶ There is no better way to check careless automobile driving than to attend the funeral of a careless driver. So we likewise reasoned that reports of accidents might emphasize the dangers more forcefully than a dozen printed pages filled with warnings. Therefore, we were pleased to receive a letter of commendation on our stand from a well-known figure in the welding field—a man who is as interested in preaching safety as we. ¶ Those whose interests have been tied in with welding for many years are prone to think that to-day everybody associated with the welding and cutting processes know their inherent dangers and how to avoid them. But, as a matter of fact, the majority using these processes to-day are newcomers as measured by the length of time they have been welding, and recruits are joining the ranks every day. In this issue, on page 34, is reported a fatal explosion which occurred in California, due to welding an oil tank. Word has come of the recent explosion of a large tank in Canada. Three men who were welding on the top were injured. Such an explosion might be traced to carelessness on the part of supervisors. Therefore, those in the engineering departments and in the superintendents' offices must be warned. They must have described to them disasters due to carelessness, if this is necessary to convince them of the reality of the danger. ¶ It's no crime to be blown off this planet; but if it happens to you, and your friends know it was caused by your own carelessness, your ghost will receive no hand-outs. While it's on your mind, get a pencil and paper and jot down the most sensible New Year's resolution you ever made. It might add many years to your life, not to mention the greater mental ease it will give your family.

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The Welding Engineer

VOLUME 18 DECEMBER, 1933 NUMBER 12

Welding Stainless-Clad Steel

■ By WM. B. KEELOR
Welding Engineer, Ingersoll Steel & Disc Co.

IF STAINLESS-CLAD steel is produced by the ingot process, welding is an important part of the procedure, and welding continues to play a leading role in the development of the clad steel into the finished article, inasmuch as most of the applications of stainless-clad steel require welding in the fabricating process. Not that all products made of stainless-clad must be welded, as many applications such as counter trim, bars, table tops, shower compartments, decorative trim, etc., have been fabricated without the use of welding; but, in the main, where the ply material is to be used for tanks, pressure vessels, barrels, and a wide range of processing and structural applications, welding is the principal method relied upon for fabricating.

Stainless-clad steels were developed because the necessarily high cost of solid stainless steel prohibits its use in many applications where heat, acid and corrosion conditions prevail. The development of stainless-clad steel is the metallurgist's answer to those applications where the non-corrosive properties of stainless steel are made available at moderate cost. The reason for this economy lies, of course, in the fact that stainless-clad steels have but a thin surface of stainless steel and a foundation or base of low-cost, plain carbon steel.

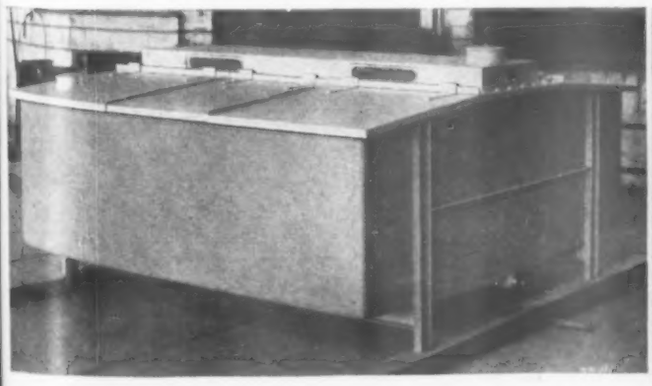
Pioneer in the development of stainless-clad steels was the Ingersoll Steel & Disc Co., a division of the Borg-Warner Corp., Chicago. This company had been producing two- and three-ply steels since 1909 in the production of their plow shares. This long experience in combining successfully hard and soft steels into ply steels proved to be a valuable background for the Ingersoll company when it faced the problem of combining stainless steel and mild steel to produce their "IngOclad" stainless-clad steel. Even with their experience in ply-steel production, it required several years of experimentation and research before they developed the ingot process, which assures a perfect bond between the stainless surface and the base metal. A brief description of this process answers many of the questions raised by the welder or fabricator who is considering the use of stainless-clad steel for the first time.

THE correct welding procedure, with either arc or gas, results in welds that are as resistant to corrosion as the 18-8 steel itself.

Producing Stainless-Clad Steel From the Ingot

Two ground stainless-steel plate inserts with a layer of insulating material between them are joined together by an unbroken weld entirely around the four sides. This single insert, consisting of the two joined plates, is then brought up to proper heat and placed in an ingot mold and held in the correct position. Hot mild steel poured into the mold completely envelops the stainless inserts, which produces a perfect weld between the stainless and the mild steel.

The composite ingot is now rolled and, of course, both the mild steel and the stainless reduce uniformly. The welding of the edges of the insert prevents defects which might result from the admission of hot metal and gases between the stainless sheets. When the rolling operation is completed, the ends and sides of the rolled product are sheared, resulting in two stainless-clad plates, each one-half the thickness of the rolled plate. In this



Milk Storage Tank, 1600-Gallon Capacity, Built of Stainless-Clad Steel by Alloy Products Corp., Waukesha, Wis., for Libby, McNeill & Libby.

Stainless-Clad Heating Element and Welded Parts of Forced-Circulation Evaporator Built by Swenson Evaporator Co., Harvey, Ind.

process there is no possible chance for scale or roll marks to appear on the stainless surfaces, because they have not been in contact with the furnace atmosphere or the rolls while rolling.

Stainless-clad steel produced by this process, patented by the Ingersoll company, is being sold to fabricators and consumers with a 20% layer of stainless backed by mild steel. In addition to sheets and plates, IngOclad is being produced in the form of roll strip as thin as 0.025 in.

Stainless-clad steel, with a tensile strength approximately 35% greater than mild steel, can therefore be used in thinner gages, and with a corresponding saving in weight and cost of the finished product over that of soft steel.

Welding is the most practicable as well as the most economical method of fabricating, generally speaking. IngOclad may be welded by most any of the processes used for ordinary mild steel. Lap welds are seldom used and should be avoided if possible. Butt welds are the most practicable and economical. Because electric metallic-arc and oxyacetylene welding are generally used, they will be described in detail.

Procedure for Welding With the Metallic Arc

In metallic-arc welding the electrode should be positive and the work negative. Electrodes should be of the proper analysis for the cladding being welded. In the case of the 18% chrome and 8% nickel cladding, it has been found that the 25 chrome, 12 nickel rod offers a corrosion resistance equal to or better than that of the stainless surface. However, jobs have been successfully welded using 18 chrome, 8 nickel rods with a carbon content not to exceed 0.07%. To date there is no record of a failure of a weld where either the 25-12 or 18-8 rod has been used, if the proper welding procedure has been followed.

Large Autoclave Made of Stainless - Clad Steel by Hamler Boiler & Tank Co., Chicago, in Accordance With Requirements of A.S.M.E. Code for Class 2 Pressure Vessels

The electrode must be of the flux-coated type, having a carbon-free coating as well as an extremely low-carbon base metal. Welds produced with such electrodes offer perfect corrosion resistance.

According to the thickness of the material being welded, two distinct methods of arc-welding clad steels are to be followed. These are shown in Sketches Nos. 1 and 2.

Another method which has been used by many fabricators in the welding of plates 3/16 in. and heavier is shown in Sketch No. 3.

Chill bars should be used wherever possible, since it is quite necessary that the weld and the adjacent metal cool quickly. On heavy material this is not necessary, since the mild-steel backing acts as a chill.

With mild steel comprising 80% of the total thickness of clad sheet or plate, the heat is dissipated much more rapidly than would be the case in like gages of solid stainless-steel sheets or plates, due to the relatively higher heat conductivity of mild steel. This natural advantage of clad steels eliminates, in practically all cases, the necessity for annealing after welding, which is in itself a costly operation.

Removing Oxide Film After Welding

Where no grinding or polishing is to be done on the weld, it is necessary to remove the surface oxide which is caused by heating. This oxide film does not offer the proper resistance to corrosion and if not removed will probably cause trouble in service. Many users sand-blast these areas, then bathe them with a solution of 15% nitric acid and 3% hydrofluoric acid to remove any steel or iron particles which might have been imbedded in the surface by the sand-blasting operation. If sand-blast is not available, a solution of 10% sulphuric acid plus 10% of salt by weight can be applied in its place, after which it is then also necessary to passivate by applying the 10% nitric acid, 3% hydrofluoric acid solution. The same procedure applies when the plates are to be heated for forming. This entire

Sketch No. 1. Method of Welding Thin Sheets.

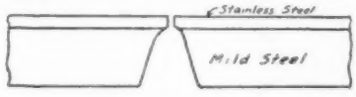
Plane or shear the parts for butt welding. For 3/16-in. and ¼-in. work, allow a slight gap between edges, but for smaller gages it is best to allow no opening:

Now weld the stainless side, using a coated alloy electrode. The amperage should be arrived at by making trial welds. Excessive current will cause deep penetration and dilution which might tend to impair the corrosion-resistance properties of the weld. With proper amperage, it is possible to fuse the edges together with little, if any, dilution. The stainless-steel cladding melts at a lower temperature than does the steel backing, which allows the stainless welding to proceed without bringing up mild steel:

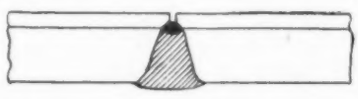
Next weld the mild-steel side as in the case of ordinary mild-steel plate. Do not use excessive heat values but just enough to promote good fusion. In the case of 3/16-in. to ½-in. plates, bevel the edges on the steel side slightly to allow for penetration in order to eliminate the use of excessive heat values:

Sketch No. 2. Method of Welding Plates.

Prepare the joint by the use of a plate planing machine like this:



Next, weld with stainless electrodes from the mild-steel side in the bottom of the groove, and ordinary steel electrodes can be used to complete the remainder of the weld on the mild-steel side, like this:



Now groove out the stainless side:

And weld with stainless electrodes:

Sketch No. 3. Alternate Method of Welding Sheets.

Bevel the steel side:

Then weld with steel or stainless electrode:

Now groove out the stainless side to get down to good, clean metal:

And, last, apply the stainless weld:

Procedure for Butt-Welding Stainless-Clad Sheets and Plates of Various Thicknesses

procedure is the same as is used in welding solid stainless steel.

The lighter gages of IngOclad may be welded by the oxyacetylene process with little difficulty if the proper procedure is followed.

Making Welds With the Oxyacetylene Torch

It is best to use a good, low-carbon, 25-chrome 12-nickel bare filler rod, 1/16 or 3/32 in. in diameter.

Cleaning, spacing, tacking, and jigging are in general the same as in the case of common mild steel. It will be found that this material performs much the same as mild steel when heated rather than like solid stainless steel.

The flame adjustment should be strictly neutral, because excess acetylene may add to the carbon content, thereby lowering the corrosion resistance, while excess oxygen may cause porous welds due to the formation of almost infusible oxides.

A good stainless-steel welding flux should be used. This is mixed to a creamy paste with water, then applied to the plate edges and also to the filler rod.

The welding puddle should be kept as small as possible and not stirred with the filler rod. The material should be heated no more than necessary to assure thorough fusion, as the operation only consists of making a continuous stainless surface.

Chill bars should be used in oxyacetylene welding. It is quite essential that the metal cool quickly.

From the foregoing descriptions of the electric and oxyacetylene welding procedures, it is evident that the successful welding of stainless-clad steels is but an extension of ordinary good welding practice for single-ply steels, be they stainless or mild. So many examples of stainless-clad all-welded products such as tanks, pressure vessels, food and chemical containers, etc., have proved satisfactory after months of service that there should be no hesitance on the part of the welder to use and recommend stainless-clad steel.

Light-Gage Sheets May Be Soldered

For the lighter gages of stainless-clad steel, where it is not practicable to weld, a stainless-steel solder may be used effectively.

In the early development of the solid stainless steels and also the stainless-clad steels, many mistakes and misunderstandings had to be overcome. The principal source of difficulties experienced in the early days of clad-steel welding were due to a failure properly to clean the welds, a failure to passivate after welding, the use of grinding wheels previously used on soft-steel grinding, which imbedded soft-steel particles at or near the weld, or the imbedding of soft steel when ordinary hand or revolving steel brushes were used. Hence corrosion sometimes appeared at the weld, and the user hastily condemned the ply steel instead of tracing the cause of corrosion to its real source.

Steel Brushes Are Source of Trouble

It is strongly advised to avoid the use of steel wool or wire brushes to clean the weld. A stainless-steel or non-metallic brush is the only kind which should be used.

When either the gas or arc welding process is employed, it is quite essential that the welders be capable and conscientious. Sample welds should be made and tested to prove the welder's ability before beginning a job. Companies furnishing clad steels maintain their own staff of thoroughly competent welding engineers who should be called upon for advice and procedures to be used in handling any questionable welding problem.

Yeast-Culture Tank Made by Alloy Products Corp., Using Stainless-Clad Sheets. All Seams Are Butt-Welded and Ground Smooth on the Inside. Tested at 600 Lb. Pressure.

Overhead Crossing Made Water-Tight by Welding

Pedestrians and street traffic passing under the new Fond du Lac Ave. overhead railroad crossing in Milwaukee, Wis., will not have to put up with water dripping onto them from the overhead structure when it rains, because welding is to be used to make a water-tight pan under the ballast. This will be a 5-span bridge, and the fabrication of the steel has already been started by the Wisconsin Bridge & Iron Works, of Milwaukee, who have the contract for furnishing the steel and erecting the structure.

Between the side girders and laid onto the cross beams will be a battledeck type of floor made from 7/8-in. steel plates. These plates will be welded together throughout their entire length, and will be welded to the supporting beams below by means of plug welds made through 5/8-in. rivet holes punched in the plate.

After completion of the flooring, stone ballast will be thrown in and then will be laid the cross ties and rails.

The entire job will involve approximately 1200 lineal feet of welding and 3000 plug welds. Hollup and Lincoln electrodes are being used.

Iowa Welding Conference to Be Held in January

The sixth annual welding conference at Iowa State College, Ames, Iowa, will be held on January 24th, 25th and 26th, according to an announcement from D. C. Faber, Director, Engineering Extension Service. A program is in course of preparation.

Certified Welders Hold Weekly Meetings

Weekly meetings are being held by Los Angeles Local No. 8, Association of Certified Welders, on Tuesday evenings at 6311½ S. Santa Fe Ave. in Huntington Park, Calif., under the direction of H. P. Staff, president. A drive for new members is being made during December with very satisfactory results, according to Secretary Earl C. Chapman, of Alhambra.

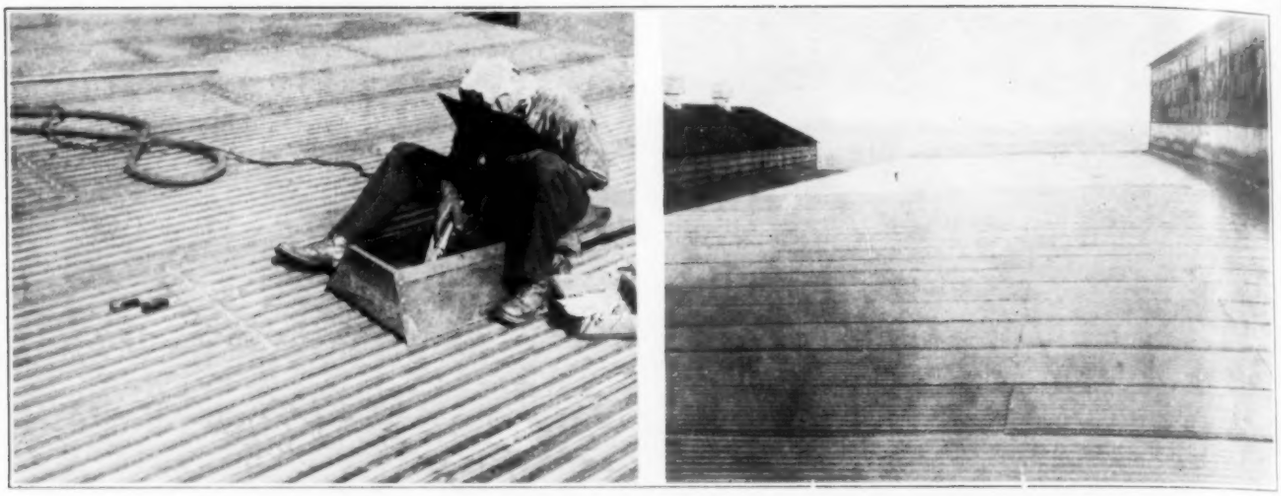
Los Angeles Section Will Visit Kobe Plant

The December meeting of the Los Angeles Section of the American Welding Society, to be held Thursday evening, the 21st, will include a visit to the plant of Kobe, Inc., in Huntington Park. This company manufactures oil-well casing and has developed the art of welding and cutting in its plant to a high degree of efficiency.

A talk by C. J. Coberley, president of the Kobe corporation, will precede the plant visit, and will outline and explain the application of cutting and welding in the manufacture of the company's products.

An interesting talk during this meeting by F. P. S. Gardner, of London, England, chief engineer for Quasi-Arc, Inc., is also anticipated.

At the meeting of the Los Angeles section held on November 23rd, interesting talks were given by G. M. Hawley and S. L. Cipperly, of the Southern California Edison Co., on "Recent Advances in Electrical Science," followed by demonstrations and explanations by G. M. Rankin of the same company.



A Close-Up View of the Welding Operation and a View of the Completed Roof.

Weather-Proof Roof Is All-Welded

Elimination aof rivets and bands in the installation of corrugated metal roofing has been accomplished in the plant of Republic Carbon Co., Niagara Falls, N. Y., by means of electrically welding the sheets. This unique installation method, using Toncan iron throughout, was developed by S. M. McAnulty, plant engineer of the company.

The roof covers a calcining plant which consists of a number of large iron cylinders in which coal and petroleum coke are reduced to graphite by heating. These pots are cooled by a water spray, resulting in hot fumes and gases being given off at the top. Since there is a considerable amount of steam in the building, the formation of sulphuric acid from the sulphurous gases in the air requires a roof which resists the attack of acid. Toncan Iron was selected because of its resistance to corrosion and acid attack.

Twelve-gage hot-rolled, annealed, pickled and corrugated Toncan Iron sheets were electrically arc-welded together with heavy-flux-coated Toncan iron welding rod. About 35,000 lb. of Toncan iron was furnished for the job by Beals, McCarthy & Rogers, Inc., Buffalo, N. Y. The sheets were coated on the inside with Elasticote and on the top with an aluminum-asphalt paint.

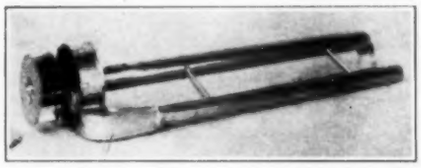
Overlapping expansion joints were placed at intervals of 28 ft. The space between the lapping and along the exposed edge was covered with glazing cement.

Such a welded, all-metal roof presents no crevices under which the wind can secure sufficient leverage to rip off sheets. Also, water cannot be driven by the wind between the sheets, resulting in a completely weather-proof job. It is said that the installation cost of this type roof compares favorably with the usual riveted and banded job. The numerous advantages of this type of installation are expected to lead to a more extensive application of welding to roofing.

Finds Means of Welding Rare Metal

When tantalum, a rare metallic element, is welded in air, the welds are very hard and brittle, according to the experience of the Fansteel Products Co., Inc., North Chicago, Ill. To obtain ductile welds with this material, this company developed a unique method of welding it.

The illustration shows a laboratory device made of tantalum of about 28 gage. The tubes are formed of thin sheets with



Tantalum, of Which This Device Is Made, Requires a Unique Method of Welding.

the longitudinal seams made by means of a resistance seam welder. The electrode points, or rollers, and the work are immersed in water during the welding operation.

For those joints where a seam welder cannot be used, the edges are slightly flared and butted together and welded with the carbon arc, without filler material. A small carbon pencil is used, and the arc must be very short to prevent burning of the material. All carbon-arc welding must be done while the work is immersed in a chemical solution. To obtain best results the arc itself must be maintained a certain distance beneath the surface of the solution, as the arc seems to be affected by variations in the head of liquid over the arc. While seam welding gives good welds in water, welding by the arc in water causes dissociation of the water into hydrogen and oxygen, and the presence of either of these gases results in a brittle weld.

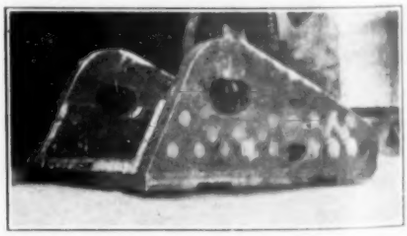
Tantalum is being used in various industries, particularly processing plants, because of its high resistance to almost all acids and to other products of chemical reactions.

Welded Steel Replaces Huge Casting

The speed with which plates were cut and welded together to replace a huge casting enabled an Illinois factory to resume operations only a short time after a breakdown.

The casting was a 50x24-in. crushing plate from a hammer mill and weighed 1500 lb. Welding of the cast-iron plate was out of the question, with the facilities available. So an order was immediately sent to Joseph T. Ryerson & Son, Inc., in Chicago, for three plates, 2 in. thick, cut according to specifications. One plate was for the bottom and two were for the sides. Two pieces of 6x6x¾-in. angle iron were also ordered.

The order was sent to Ryerson in the morning, the material was cut by torch



Crushing Plate Built of Welded Steel.

that day, and was on the train that night. Arriving at the customer's place the next morning, the base was machined and it and the side plates and angles were drilled for rivets. The plates were then assembled and welded, and the plant was in operation only a few hours later. The new plate is much stronger than was the old cast-iron plate.

Bronze-Welding a Large Gear

Fracture was gouged out with a carbon arc, using 600 amperes, and then the gear was preheated and welded with oxyacetylene

By L. C. MONROE

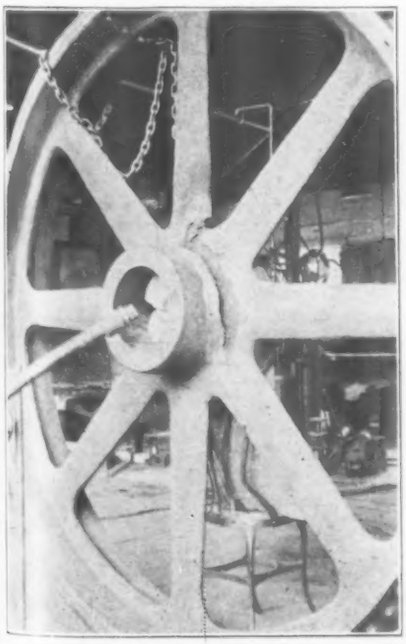
IN THE bronze-welding repair of a large gear, the Wayne Welding & Supply Co., of Fort Wayne, Ind., gouged out the cracks with a carbon arc and obtained the high amperage required by connecting two welding units in parallel.

This was a main crankshaft gear from a shear used to cut 4x4-in. billets in a mill. The gear was 9 ft. in diameter; the face or width of the rim was 12 in.; length of the hub 18 in.; while the welded part of the hub had a thickness of about 5 in. The gear was made of semi-steel.

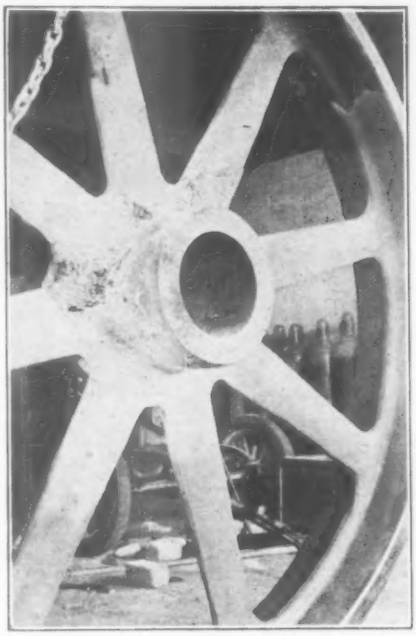
The hub was broken in several places, probably caused by a severe strain on a positive clutch located on one end of the hub. At the clutch side of the hub, the break extended completely through, and then traveled back on the hub around the spokes and back to the clutch face again. This occurred in two places, causing 37 lineal inches of fracture which had to be welded. At no place did the break extend the full length of the hub.

Bronze welding was decided upon owing to its high strength, less serious problem of expansion, and assurance of more perfect alignment when the job is completed.

The cracks were grooved out with a



View of Part of Fracture After Veeing Out With the Carbon Arc.



View of the Fractured Gear From the Clutch Side.

5/8-in. carbon, a current of 600 amperes being used. Since no 600-ampere electric welder was available, two Hobart welders (one rated at 300 amperes and the other at 200 amperes) were used with their welding circuits connected in parallel. This arrangement, by utilizing the overload capacity of these machines, gave the necessary current. About 6 hours was required in grooving out. A slight preheat from a gas burner was used on the hub to compensate for expansion caused by heat from the carbon arc. With skillful manipulation of the arc, the grooves were made sufficiently smooth so no chipping was necessary in preparing the chamfer.

Immediately after grooving out, two gas preheating torches were placed on opposite sides of the rim in such position that the flames hit the rim at practically a tangent. A sheet-iron inverted trough, curved to fit the contour of the rim, caught the heat from each torch and carried it along the rim, resulting in a large section of the rim being preheated by each torch.

Welding was started as soon as the heat was placed on the rim. Two Rego torches with No. 41 tips were used. Two welders were assigned to each torch. Each welder would weld for 15 minutes and then rest for 15 minutes, then weld for 15 minutes more, and so on. During about half of the welding, both torches were in use. Some plan of spelling off was used during the periods when only one torch was in operation.

As the weld progressed, each welder would wash down the surface with his torch so no finishing was necessary upon completion of the job.

The preheating flames were not turned off the rim until quite some time after the welding was finished in order to eliminate contraction strains as much as possible. The gear was then allowed to cool over night.

After the fractures occurred and before the gear was delivered to the shop for welding, the surface of the hub on the clutch side was machined straight back from the face of the clutch, so a steel band could be fitted around this section of the hub after the repair was made. Accordingly, a steel band 1 in. thick and 3 in. wide was shrunk around the hub after the gear was completely cooled off, and the band was tack welded to the hub by arc welding. The gear was then returned to the mill and put into service. The alignment was found to be perfect.

The gear has now been in operation for a sufficient length of time to prove the quality of the weld. The job consumed 131 lb. of bronze, and the total time was 60 hours flat.

The Completed Job.

In this article, taken from a paper given before the American Society of Mechanical Engineers, New York City, December 6th, Mr Chapman discusses at length the effective use of welding in making

Homogeneous Joints in Structures

■ By EVERETT CHAPMAN
Vice-President in Charge of Engineering,
Lukenweld, Inc., Division of Lukens Steel Co.

THE science of structures is concerned with the economic distribution of elastic material to connect a load to its reactions over a reasonable length of time. Intimately associated with this broad subject are the various methods used to join the component members of the structure.

While the physical properties of elastic materials and the engineering details of their distribution are important factors, this paper is primarily concerned with the production of ideal joints.

Homogeneous Joints Have High Efficiencies

Any structure built of pieces must necessarily act as a whole under its applied loads. Joint efficiencies, therefore, determine the action of the structure. As the unit stresses are raised, high joint efficiencies become more and more important. As the loading cycle becomes more and more frequent, homogeneous joints become imperative.

Properly welded joints are more nearly homogeneous than any other type of connection between two pieces of material. Homogeneous joints are eminently desirable since they particularly affect the rigidity and fatigue performance of the structure.

Consider the two methods of supporting a load over a span, as exemplified in the sketches in Fig. 1. The usual truss and abutment arrangement is essentially a three-piece structure, connected by pin joints. The rigid frame bridge is a one-piece structure in which the transition from horizontal to vertical members is distinguished by the fact that this apparent joint can transmit bending moments. In the one-piece rigid-frame bridge, the bending moments are distributed uniformly over the entire structure. The vertical and horizontal members interact to redistribute the bending moments. When, as in this case, adjacent members interact through a rigid junction, the redistribution of bending moments may effect an economy of material running as high as 30%. Considered broadly, the type of joint at the knee of the one-piece rigid-frame bridge is the joint inherent in a properly welded design.

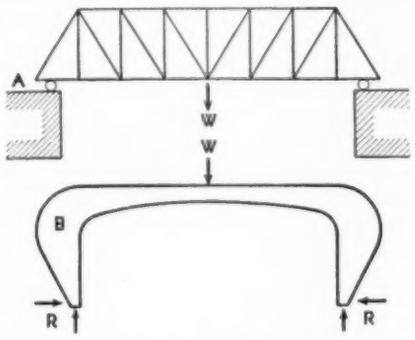


Fig. 1. Examples of Two Types of Spans for Supporting a Load.

Two plates can be welded together so that the joints, as such, vanish. A homogeneous joint, or transition between two pieces of material, is a joint whose elastic behavior cannot be distinguished from that of the same configuration cut from a single piece of material. In the unattainable ideal, the maximum stress would have the same value as the average stress. It is thus indicated that a definite though intangible advantage continually permeates the welded steel structure. Since the joints can be made so that the continuity of rigidity is perfectly preserved in the transition from one member to another, the structure will act as an elastic entity.

Welded Joints Possess Continuity of Action

The fact that this ideal can be closely approached in welded joints has two implications for the structural designer:

First, as has been mentioned, is the fact that continuity can be taken into consideration in the design of gross structures such as bridges and buildings in which the moment of inertia of each member is much less than the corresponding constant for the whole structure. Welded design is eminently adapted to the curvilinear structures which result

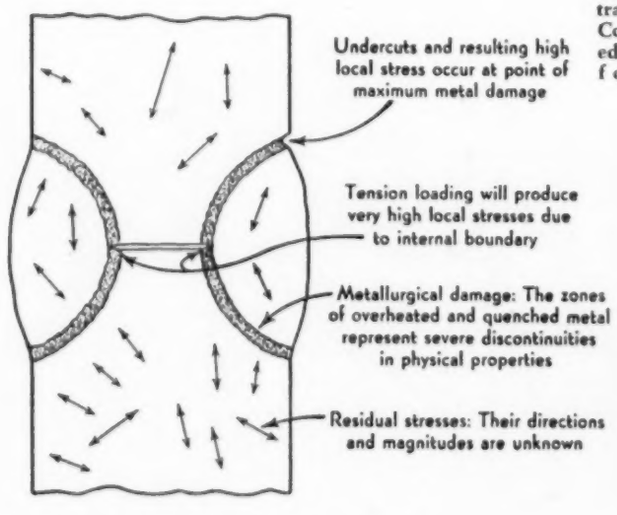

Undercuts and resulting high local stress occur at point of maximum metal damage
Tension loading will produce very high local stresses due to internal boundary
Metallurgical damage: The zones of overheated and quenched metal represent severe discontinuities in physical properties
Residual stresses: Their directions and magnitudes are unknown

Fig. 2 (left). Illustrating Some of the Conditions in a Welded Joint Which Make for Non-Homogeneous Action.

Fig. 3 (below). Specimens of Welded Joint With Unwelded Internal Boundary, Pulled to Destruction.
(Specimen at left is of brittle material and that at right of ductile material. Photoelastic image in center shows high stresses at edges of internal boundary.)

when continuity of elastic action is considered in the design.

The second implication is that the behavior of the properly welded structure, under impact and fatigue load, is similar to that of a jointless structure as far as service life is concerned. The entire structure's resistance to severe loading conditions represents the thoroughly consolidated resistance of its components.

A homogeneous joint has two characteristics: First, the material comprising the joint must have uniform physical properties from point to point; it must not have been damaged in any respect by the fabricating process. Second, the distribution of stress throughout the joint, from point to point, should be of maximum uniformity. A perfect distribution of stress over the joint is also an unattainable ideal since the joint, at its best, represents an abrupt change in contour.

With a homogeneous joint of the desired characteristics, the two members are

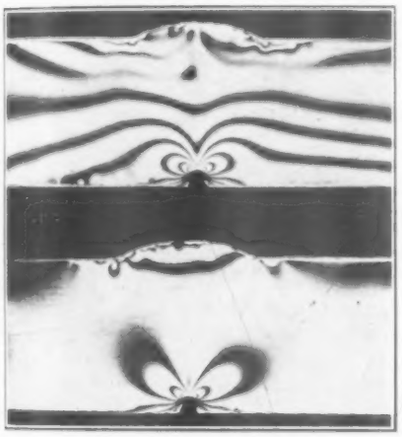


Fig. 4. **Photoelastic Study Showing Stress Distribution in Butt Welds Made Without Full Penetration.**

joined in such a manner that neither the elastic action nor the plastic action of the composite is distinguishable from the action of a single piece. Again, the joint has vanished.

Destructive Factors Should Be Avoided

Whenever a welded joint, whatever its type, functions in a non-homogeneous manner, one or more of three destructive factors are operating: sharp changes in contour, damaged material, and preloading.

Fig. 2 represents graphically the abortion which can result from the improper execution of a welded joint. This joint is far from homogeneous. The physical properties are not uniform from point to point, since there are zones of badly damaged metal. The stress values throughout the joint, when loaded, vary tremendously from point to point, because, in addition to the stress concentrations which exist at internal and external boundary discontinuities, the unknown residual stresses add to the concentrated load stresses, and thus produce utter chaos. Note the points of extreme concentration at the ends of the internal boundary and the points of lesser stress concentration at the ends of the reinforcement and around the undercut. Zones of badly overheated and quenched

Fig. 5. **Stress Concentrations Produced by Overlapped Weld Metal.**

parent metal surround the weld metal. The situation is further aggravated by the coexistence of damaged material and high stress at the same place. The undercut localizes a high stress at a point where the parent material is in its poorest condition.

Fig. 3 shows the heterogeneous stress condition which exists in an improperly designed welded joint. This photoelastic study represents a loaded butt joint between two pieces of metal of equal thickness The two welds, deposited from each side, did not meet at the center. The unfused portion forms an internal boundary which produces an extreme variation in stress over the joint. At both ends of this crack, the stresses are very high. In addition, intermediate high stresses exist at the ends of the reinforcements which are usually, and vainly, applied in order to strengthen this type of joint. Such reinforcements are effective only under static load. But under impact or fatigue loads, the changes in contour at the ends of the reinforcements introduce additional stress maximums.

Fig. 4 represents a stress distribution usually found in a weld made from one side of a plate. Such welds frequently introduce ragged contours, since the form of penetration of the weld metal cannot be completely controlled from one side. Where the design of the structure is such that welding from both sides is impracticable, the use of backing-up strips permits the production of a compromise contour which is at least predictable.

Fig. 5 illustrates the stress distribution around another common type of defect (overlap) which often occurs at the hands of an inexperienced welder. It is caused by running over of the molten weld metal onto the surface of the plate, where it merely solidifies instead of fusing with the parent metal.

Fig. 6 emphasizes another of the many forms of vicious stress distribution that may creep into a structure. It contrasts the stress conditions around a fillet weld having a concave contour with that around a fillet weld having a triangular cross-section. The triangular-throat weld, while having a lower average stress due to its greater throat dimension, has higher maximum stresses because of the abrupt change in contour that it represents. The concave-throat weld has a smaller throat area and therefore possesses a higher average stress, but its points of maximum stress are considerably lower than those in the triangular-throat weld.

Removal of Weld Metal May Relieve Stressed Condition

There are many instances permeating the entire machine-design picture in which the proper procedure to rectify a succession of fatigue failures is to remove metal rather than make an addition to the existing section. The effect of removing metal properly is to raise the average stress a few per cent, while making a reduction of several hundred per cent in the values of the maximum stresses. The concave-throated weld fillet is a case in point. The concave-throat contour provides the most uniform distribution of stress and is the closest approach to the ideal that can be obtained in practice. The conventional term, throat dimension,

Fig. 6. **The Triangular Fillet Weld (at right) Shows Higher Lcoal Stresses Than the Concave Weld (at left).**

Fig. 7. Cracks Produced by High Local Stresses Originating in Improperly Designed Welds. First View at Left is Photo-elastic Image Showing Concentrated Stresses Caused by a Bit of Extraneous Weld Metal Left by the Welder.

has no meaning in this case since the technique involved in removing the internal boundary consisted of welding completely through the joint.

Fig. 7 shows a failure resulting from a slovenly job of welding. The fatigue crack centered about the stress concentration produced by an extraneous bit of weld metal carelessly left by the welder to project from an important boundary of the structure. It should be noted that the doubly aggravated condition which exists when a point of high stress coincides specifically with a zone of badly damaged parent material is the rule rather than the exception in all of the joints illustrated.

Fig. 3 contrasts the action of the stress distribution resulting from an unwelded internal boundary on a ductile and on a brittle weld metal. The ripping action, which starts from the inside, reduces the apparent strength of this joint materially. The brittle weld metal shows a fracture without an attendant change of shape, while the ductile material, through a plastic deformation at the points of high stress, enables the structure to change its shape to a degree which materially raises the actual strength of the joint.

It should be emphasized that the mechanism of ductility is not available for the correction of structural discrepancies in those cases where the load is of a repeated nature.

Welding Heat Affects Structure of Metal

The second destructive factor—damage to the parent metal by the extreme heat of the welding operation—is illustrated by reference to the photomicrograph of .40 carbon steel in the as-welded condition, the second micrograph on the left in Fig. 8. The large grain size is indicative of the high temperature to which the parent metal has been raised by the heat of the arc. The metallic heat path to the body of cold parent metal forms an excellent thermal sink, and the resulting rapid heat flow away from the weld thoroughly quenches the heated zones around the weld. The net result is a zone of highly overheated and quenched material adjacent to the weld. The severity of damage in this zone is a particular function of the carbon content of the parent metal, or, more generally, a function of the air-hardening ability of the steel.

This damaged zone, whatever its extent, represents a discontinuity in physical properties, since the large, overheated grain is decidedly weak in resistance to fatigue and impact. In addition, the hardened micro-constituents, due to the quenching action, are very strong, but they lack the ductility necessary to compensate for the thermal stresses to which the piece is subjected in the welding operation. The joint may crack through the damaged zones during fabrication, and this phenomenon may be carried over into the service behavior of the structure if the damage is not corrected.

Contraction of Weld Metal Causes Preloading

Third of the destructive factors is the element of residual stress introduced in the structure through contraction of cooling weld metal. Little is known of the direction and magnitude of these thermal stresses. However, there is direct evidence that the residual stresses, in many cases, may exceed the yield point of low-carbon steel. When a known service load is superimposed on a structure which is already loaded by residual stresses in an indeterminate manner, the elastic conditions existing from point to point are highly chaotic. The structure may be so highly preloaded that its permissible load in service is only a small fraction of the designed load.

Structures, the natural shape of which is such that the stresses are self-locking, often fail through the partially completed welds during fabrication, due to some shop-handling condition (such as hammering or dropping) which applies even a small shock load to the structure. This behavior is not due to "brittle welds," as has been commonly supposed. In addition to the elastic chaos that residual strains may produce in a welded structure, severe warping will occur when the strains are relieved, either in the machining operation or by a gradual creep over a period of time. As an example, a battery of machines, in which proper functioning depended upon maintained accurate alignment, was rendered progressively ineffective as the machine housings gradually crept out of shape, and at the end of two years the machines were useless.

Adverse Factors Corrected by Design and Heat-Treatment

Correction of the destructive factors which are present in non-homogeneous joints simply revolves around two elements: first, drafting-room practice, and second, heat-treatment.

As it is concerned with the design of the joints, drafting-room practice must be carefully supervised to insure that none of the defects, or defects of types shown in the examples, are allowed to creep into the structure. Design practice can no more afford to neglect the stress distribution in the joint than it can afford to neglect the stress distribution throughout the gross body of the structure. In fact, the problem is more acute in the case of the joints, simply because of the fact that the variables entering into the production of a joint are less standardized than those which enter into the manufacture of the steel plate.

The effect of a notch in breaking brittle material under a single load is only too well known in the case of the age-old method of breaking glass. The equivalent effect in a ductile material is not marked when the load is applied only

once. But the exact effect is duplicated when the load is of a repeated nature. It is astonishing that, in view of this fact, notches as a species do not seem to be generally recognized. It is only a notch in a particular form which has caused trouble that receives any recognition. It is well known that prick punch marks and scriber marks and stamped initials must not be applied to locomotive or airplane components. Just why the identical phenomenon, in the shape of undercuts and unwelded boundaries and triangular weld contours, is blissfully incorporated in high-duty welded structures is difficult to explain. It has, however, resulted in failures.

Heat-Treatment Should Follow Welding Wherever Practicable

Correction of damage to parent metal necessitates a heat treatment after the structure has been welded. The series of photomicrographs shown in Fig. 8 illustrate the effect of welding, stress-relief and treatment at the two critical temperatures, of two pieces of steel of different carbon content.

It is seen that the .40 carbon steel, in the as-welded condition, is martensitic, while the .24 carbon steel shows evidence of the original austenite with troostite forming at the grain boundaries. It is to be noted also that the grain has been enlarged considerably. The probable characteristics of these two zones are extreme brittleness, no ductility, and a general weakened condition due to the large grains. With such characteristics, these zones cannot absorb any energy, as they would be called upon to do in the case of an impact, and furthermore, they have no self-relieving properties under thermal stresses because of their lack of ductility. The effects of the usual stress-relieving treatment at 1200° F., followed by a furnace cool, are illustrated in the third group of two pictures. 1200° F. is usually considered sufficient for stress-relief, since at this temperature ordinary low-carbon steels have a yield of only about 2000 lb. per sq. in. This means, of course, that any greater residual stress will produce plastic deformation, and will, therefore, vanish for all practical purposes. The preloading which was introduced by the contracting weld metal has ben removed. 1200° F., however, if held for a proper length of time, will serve to break down the harder micro-constituents which are formed in the damaged zones. It will not, however, refine the grain, since the carbon does not go back into solution at this temperature. It is also to be noted, then, in the third group of two pictures delineating the 1200° F. treatment, that the martensitic and troostitic phases in the two steels have been broken down to what is probably a finely divided sorbite, and it is reasonable to suppose that the residual stresses after this treatment are under 2,000 lb. per sq. in. Experience indicates that welded structures which have received this treatment will retain their shape during machining and indefinitely therafter.

Treatment at 1350° F. partially refines the grain, while treatment at 1650° F., followed by cooling in still air, represents the maximum degree of refinement that can be obtained. This ideal, in which the pearlite and ferrite are in the finest possible condition, is hardly practicable, since most welded structures could not be removed from the furnace at this temperature without incurring a severe distortion. In fact, furnace cooling from 1650° F. is rarely practicable, since light-weight, high-duty structures may suffer severe distortion in the furnace due to their own weight.

The practical compromise that represents the best commercial practice is, therefore, a soaking treatment for one hour per inch of maximum thickness at 1200° F., followed by a slow furnace cooling. Under more rigorous service conditions a gain can be practically ef-

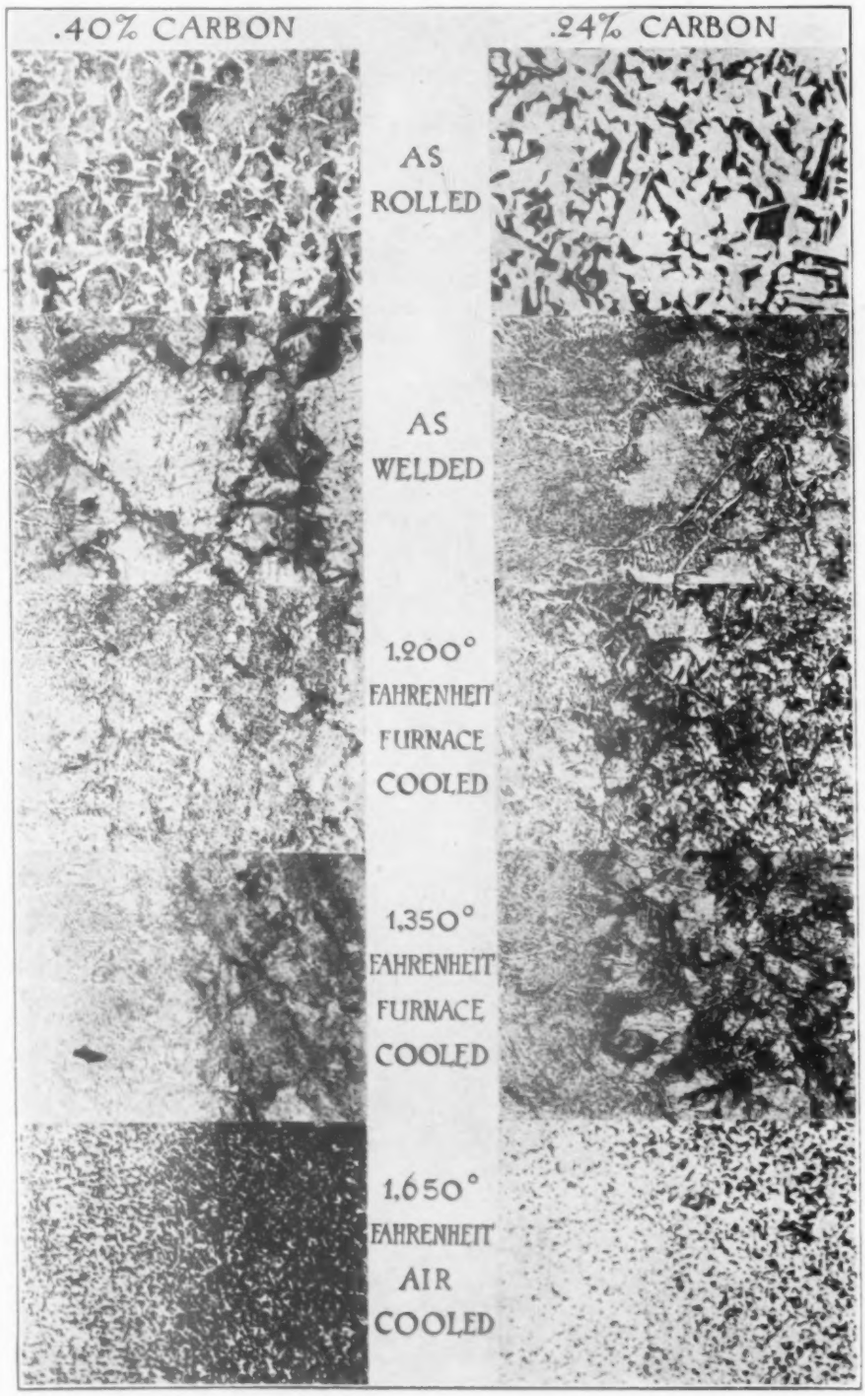


Fig. 8. Photomicrographs Showing Effect of Welding and Heat-Treating of Two Pieces of Steel of Different Carbon Content.

(The top micrographs represent the as-rolled condition of 2-in. plates. All the other pictures were taken on the very edge of the weld metal and illustrate the effects which occur in the parent metal. Magnification, 100 diameters, then reduced one-sixth in reproduction. Etched with nital.)

fected by raising the temperature to 1400° F., at which the grain undergoes partial refinement.

Use Low-Carbon Steel if Annealing Is Impossible

The importance of keeping the carbon content of the steel in the lower ranges is graphically represented in the series of photomicrographs. The local damage done to the higher-carbon materials more than offsets the higher average properties which they represent. The magnitude of the brittle phases which are present is a function which increases rapidly as the air-hardening ability of the steel is increased. In the case of the carbon steels, this is, of course, a function of the carbon contents. It is through specifications of carbon content that the welding of large structures such as bridges and ships, which cannot be furnace annealed, will become practicable.

However, even where metallurgical damage has been minimized in this manner, the problem of stress-relief is not solved. As more is known of the nature of residual stresses, mechanical peening will offer a compromise solution which will enable the full possibilities of welded construction to be realized by the designer.

The carefully executed ideal, in which contours have received proper attention and which has been properly heat-treated, need have a lower factor of safety than any other type of construction: it is more predictable. High degree of predictability goes hand in hand with a low factor of safety. As the service duties increase and more and more is demanded of the available structural materials, the factor of safety must be reduced.

Modern transportation trends are imposing high duties on available structural materials. Careful design and selection of materials are the only path to uniform-stress, one-piece structures. In such structures, the joint as an entity must vanish. The behavior of a properly made welded joint under any kind of load or load cycle cannot be distinguished from a single piece of rolled steel.

A. S. T. M. Headquarters Take Larger Space

After 14 years in the Engineers' Club Building, Philadelphia, the headquarters of the American Society for Testing Materials has been moved to the Atlantic Building, 260 S. Broad St., just half a block away from the former location. The new headquarters will have 40% greater total floor area, including 60% more space for the Society's offices. The offices are on the fifth floor, and storage space has been taken on the fourth floor. The fifth-floor space includes a large and attractive Board Room, as well as a reception room and members' lounge.

Get "*H. O. T.*" on Welding

■ Edited by
H. O. T. RIDLON
Welding Consultant, Joliet, Ill.

[This section is dedicated to Better Welding and Better Welding Shops. Suggestions and criticisms are invited.]

Hints on Bronze-Welding Malleable Iron

Believe it or not, for some time I thought some of you boys were kidding the Old Maestro when you wrote in telling me about jobs you've done on malleable iron and steel-to-malleable that had failed. Frankly, it was hard for me to believe that anyone would not know how to weld it. Well, gentlemen, there is only one way I know to successfully do this job and that is bronze-weld it. And to bronze-weld, thoroughly clean the piece to be repaired (if you can sand-blast the area to be welded, by all means do it); then chip a deep, wide vee along the fracture and, if possible, a double vee if you can weld it from both sides. And when I say "chip" I mean nothing else. Grinding brings the graphite to the surface and makes tinning difficult. Now here are a couple of good hints to follow when bronze-welding: (1) always melt the rod with the envelope flame of your torch, and (2) never melt your bronze deposit without adding more bronze.

For many months the manufacturers of bronze-welding rods have been extolling the virtues of using bronze. They offer you literature that contains plenty of splendid information, and samples. But don't try to run your business on samples; people will get so they won't like you. But there is lots of free and very helpful knowledge offered to you.

* * *

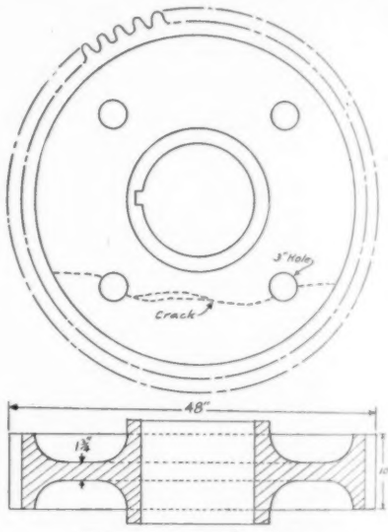
A certain Indiana welding equipment peddler was getting his shoes shined in the barber shop at the Fowler Hotel during the recent Welding Conference at Purdue University, when some sinner put his head in the door and yelled: "Give that guy a flat rate—he's got flat feet."

* * *

Out of the Scrap Pile

The other day I was called into a large plant to examine a cast-steel gear weighing about 1600 lb. The sketch gives the details. The crack, shown by the dotted line, was veed out from both sides with a cutting torch to about a 60° angle, leaving about ⅛ in. in the middle. Then the piece was brought to an even heat of about 800° F. in the forge, and thoroughly wire-brushed. Using a protected-arc rod of exceptionally high quality, we tacked it securely on both sides of the holes and about midway between the holes. Then the piece was turned over and we welded one bead the entire length of the crack. The slag was then removed, and with a caulking tool and air hammer we peened the weld metal slightly to relieve any residual stresses that might be there; this also prevented overheating of the work. Then we turned the piece over and proceeded the same way on the other side, using a 5/32-in. rod, and so on until the job was finished, lacing each bead carefully with a very slight weaving of the bead.

The results were perfect and very pleasing to our friend and customer because their men had attempted the job,



Sketch of Cast-Steel Gear.

following the wrong procedure, and made a very miserable failure of it, so it seemed as if they were going to be down for weeks waiting for a new gear while it was being cast. But, instead, in three days the machine was back in service and their men back at work.

* * *

A Merrie Christmas to Ye and a Profitable New Year

Christmas will soon be here and I sincerely wish you all a very Merry Christmas and hope you find you've made a profit this year.

Then it will be New Year's and here's hoping you all have a swell and profitable year in 1934.

And I'll try hard to make the column bigger and better in 1934. But may I ask my friends to write to me and let me know what I shall include in my scribblings? Write just as often and much as you want, for this is your column and we need your help to improve it.

Thanks! and here's to luck and bigger, better and more profitable "biz" in 1934.

Fig. 1. Two "Long Arc" Welded Separating Tanks of Ordinary Tough Pitch Copper, Fabricated by Hibben & Co., Chicago, Ill., Under Supervision of The Hobart Bros. Co., Troy, Ohio.

Fig. 2. Large Copper Mixing Vat Placed in Semi-Inverted Position for "Long Arc" Welding on the Bottom, So the Operator Can Weld in the Downward Position.

Food Processing Vats Made of Welded Copper

Widespread comment aroused by the article in the September, 1933, issue of THE WELDING ENGINEER dealing with the new "Long Arc" method of welding ordinary tough pitch copper, indicates that there may be some misunderstanding as to the breadth of the field in which the new method may be useful. At any rate, there is evidence that many believe it to be of interest only to such plants as may be engaged in the fabrication of brewery and distillery equipment.

While it may be true that those industries that have just been revived by changes in our country's laws offer the largest market for copper vessels at the present time (and perhaps for some time to come), it is also true that there are other applications for this new money-saving development. In fact, the original article cited at least two instances where it had been used with profitable results in other industries and, since its publication, several other instances have come to light.

The pictures herewith, for example, show three vessels recently fabricated of ordinary copper for a food products company in the Chicago district. They are two large copper separating tanks and one large copper mixing vat to be used in the processing of cereal food products not in any way connected with either the brewing or the distilling industry. All three were fabricated in the plant of Hibben & Co., South Chicago, Ill.

The work was done under the direct supervision of Robert Bercaw, who was responsible for developing the new arc-welding technique for The Hobart Brothers Co., Troy, Ohio. By special arrangements with that company, Hibben & Co. engaged his services for one week, during which time he not only supervised this particular job but also instructed the local operators so that they are now prepared to handle similar work without outside assistance. Here are a few statistics covering this work.

One of the tanks shown in Fig. 1 is 5 ft. in diameter and 7 ft. high, while the other is 4½ ft. in diameter and 6 ft. high. The outlet in the head of the former is 8 in. in diameter, while the latter has a 12-in. opening. The concave heads are formed of 5/16-in. copper plate, with dividing fins of ¼-in. copper, "Long Arc" welded on the under side and at right angles to the head. The outlets in both heads were rolled from 5/16-in. copper and were made 12 in. long with about 6 in. of length extending into the interior of the tank. The longitudinal seams of the outlets were arc welded, and flanges approximately 3 in. wide, of 5/16-in. copper, were arc welded to the outlets at the outer end to provide for pipe connections when making the final plant installation. The side outlets were also of 5/16-in. copper, cut and hammered to shape, arc welded where necessary, and arc welded to the square openings that had been cut in the cylinders.

Fig. 3. Plates Held in Position With "Todt" Welding Clamps, Ready for Tack Welding.

The main cylinders were rolled from 5/16-in. copper plates and the longitudinal seams were arc welded. The bottoms, cut from the same material, were also arc welded to the cylinders, as were the concave heads. All joints were welded both inside and out as a matter of extra precaution, due to the fact that the containers must withstand considerable vacuum in actual use.

Fig. 2 shows the operator "Long Arc" welding a large mixing vat, held in a semi-inverted position. This vat is 12 ft. long, 6 ft. wide, and 6½ ft. deep in the center. It is constructed of ¼-in. copper. The ends were first completed by arc welding the rectangular plate to the triangular plate for each end. Then two copper plates, each 4 ft. wide, were formed to match the shape of the completed ends and one was welded to each end, thus forming two-thirds of the longitudinal dimension of the sides and bottom of the vat. A third plate of copper of the same width, formed to the same shape, was then arc welded between the two end assemblies to form the remainder of the sides and bottom and give the vat its 12-ft. length. The butt joints were arc welded only on one side, but the corner joints were arc welded both inside and out.

None of this work was preheated. All welding was done by the "Long Arc" method with Hobart Brothers' Hobronz rods. All work was handled so that the welding was in a downward position. In placing the plates for the longitudinal butt welds on all three pieces, they were held in place for tack welding by means of special clamps provided by The E. G.

Todt Co. (inventor and manufacturer), South Chicago, Ill. After tacking securely, the clamps were removed, and the final welding proceeded at the rate of 12 lineal inches per minute.

The work was done with ⅜-in. carbon electrodes and 100 lb. of ¼-in. Hobronz filler rods. The welding current ranged from 300 to 350 amperes at 50 volts for the various joints. Owing to the inaccessible location of the work, it was necessary to use very long welding cables with the Hobart 16-kw. (400 amp. 40 volts) arc welding machine. Due to the voltage drop in the long cables, the potential at the machine was approximately 60 volts.

Welding Shop Offers Library Facilities

A comprehensive library of welding periodicals and catalogs has been established by the Storts Welding Co., Inc., 42 Stone St., Meriden, Conn. The facilities of this library, located in the plant of the Storts company, are being offered to manufacturers and fabricators.

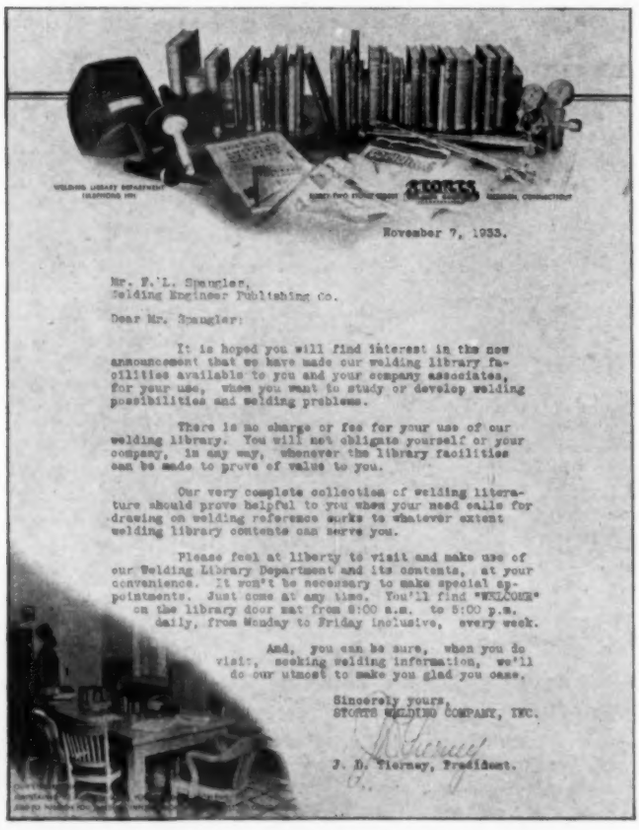
"During our experience in the welding job and contract business," writes J. D. Tierney, president of the Storts company, "we have been endeavoring for years to collect a good reference library on welding subjects, and the thought occurred to us that there was a whole lot of goodwill and confidence to be gained by allowing others, who have no welding library facilities, access to our welding literature, our objective being to aid them as far as possible to work out their welding problems.

"We have mailed copies of the attached letter to approximately 1800 manufacturing concerns located in New England, New York and New Jersey, and we intend to follow up our initial letter with more mailings from time to time, the contents of which will familiarize our mailing list with some of the welding literature contained in our library and with other special advantages which the library offers.

"For instance, we are tying in a cross-index system on a source-of-supply file where it will be our endeavor to maintain contact with every manufacturer of welding supplies and equipment. Such a source-of-supply file will allow us to help Eastern manufacturers in immediately locating contact with sources of supply for their welding apparatus and supply needs.

"Tied in with the source-of-supply file, we will also file a list of manufacturers who market other products which indirectly relate to welding.

"The addition of the Welding Library Department to our customer service is experimental—an advantage of no great value at present other than the amount of publicity and advertising it will temporarily bring. However, it is our belief that it will prove valuable to hundreds of manufacturers who have, or will eventually be interested in developing, their own shop welding departments for production problems or for general repair problems to a limited degree."



November 7, 1933.

Mr. F. L. Spangler,
Welding Engineer Publishing Co.

Dear Mr. Spangler:

It is hoped you will find interest in the new announcement that we have made our welding library facilities available to you and your company associates, for your use, whom you want to study or develop welding possibilities and welding problems.

There is no charge or fee for your use of our welding library. You will not obligate yourself or your company, in any way, whenever the library facilities can be made to prove of value to you.

Our very complete collection of welding literature should prove helpful to you when your need calls for drawing on welding reference works to whatever extent welding library contents can serve you.

Please feel at liberty to visit and make use of our Welding Library Department and its contents, at your convenience. It won't be necessary to make special appointments. Just come at any time. You'll find "WELCOME" on the library door mat from 8:00 a.m. to 5:00 p.m. daily, from Monday to Friday inclusive, every week.

And, you can be sure, when you do visit, seeking welding information, we'll do our utmost to make you glad you came.

Sincerely yours,
STORTS WELDING COMPANY, INC.

J. D. Tierney, President.

This Attractive Letterhead, Showing a Bookshelf With Literature on Welding and a View in the Library, Is Used by the Storts Welding Co. to Call Attention to Their Library Facilities, and the Letter Invites the Prospective Customer to Feel at Liberty to Visit the Library.

Record Attendance at Purdue Conference

In point of attendance and interest shown, the Ninth Annual Conference on Welding held at Purdue University, Lafayette, Ind., Dec. 7th and 8th, set a new record for these clinics. The total registration was 327, or 33% greater than last year. In fact, at the close of the first day's session, the previous record registration had been exceeded. The program, including papers, exhibits and demonstrations, was in charge of W. A. Knapp, professor in charge of the Engineering Extension Department, and J. D. Hoffman, head of the Department of Practical Mechanics.

Exhibits and demonstrations were given by the J. D. Adams Co., Air Reduction Sales Co., The American Brass Co., Handy & Harman, Hobart Bros. Co., W. J. Holliday & Co., Imperial Brass Manufacturing Co., The Lincoln Electric Co., The Linde Air Products Co., Sutton-Garten Co., Wayne Welding & Supply Co., and Westinghouse Electric & Manufacturing Co.

Welded Steam Engines for Transport Equipment

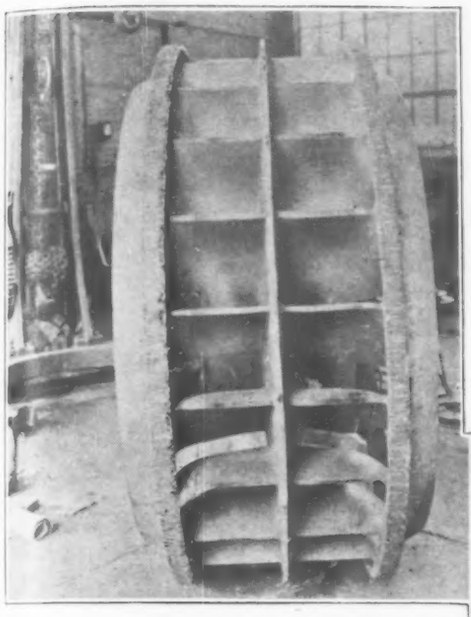
The Besler Systems, of Oakland, Calif., and Davenport, Iowa, who recently constructed and flew the first steam airplane, are now applying this principle of power generation to buses, trucks, railroad cars and light switching engines. The work is being done in the plant of the Davenport Locomotive & Mfg. Corp., Davenport, Iowa, of which Paul Doxey is superintendent.

The steam is generated in a small, compact but efficient boiler of all-gas-welded construction. The outer boiler shell is of KA2 steel and the fire box is of 16-gage Nichrome. Six hundred feet of Shelby seamless steel tubing is required for the power plant. This tubing ranges in size from ½ in. with 16-gage walls to 1 in. with 3/16-in. walls, and is received in 20-ft. lengths and joined by oxyacetylene welding. The tubing is then subjected to a 10,000-lb. cold-water test.

The boiler generates steam at 1500 lb. pressure and 800°F. Steam is generated by fuel oil of 28 gravity or up. Starting from cold, less than one minute is needed to generate steam.

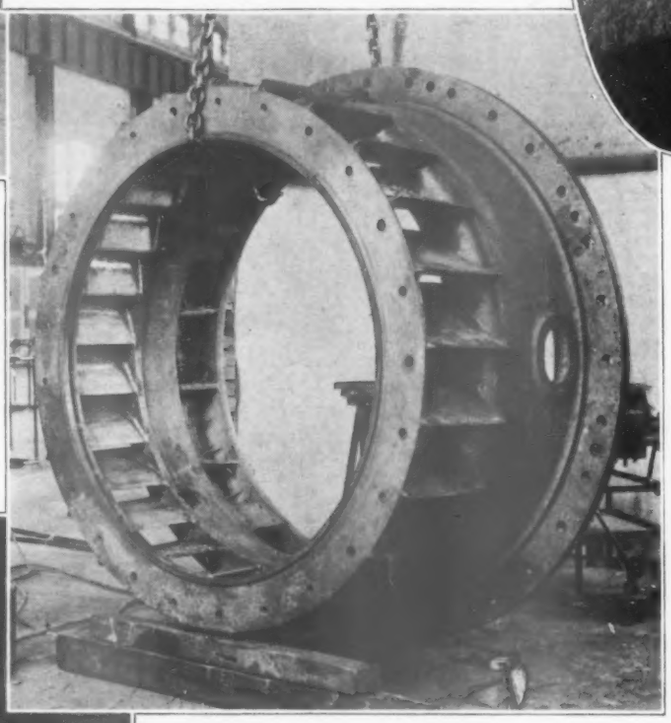
The water route is from water tank to pump, to feedwater heater, to bottom of boiler, to engine, to exhaust, to turbine, to feedwater heater, to condenser, and back to water tank. The entire route of the water is of gas-welded construction. There is very little loss of water, and such loss is caused by fast acceleration. At reasonable speeds, practically no loss occurs. In practice 500 to 1,000 miles can be covered on 10 gallons of water, it is claimed.

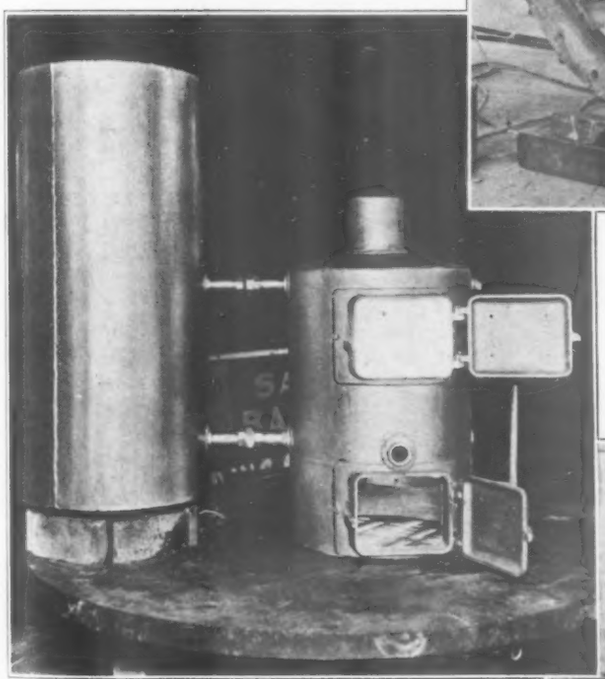
WELDING NEWS IN PICTURES



Hydraulic turbine with manganese-steel blades cut out and new ones cast and welded in, using Ascoloy rod applied with the arc. Net welding time, 34 hours. Haynes Stellite applied as hard-facing. Same material used to build up flange. Work done by the Menna Welding Co., Toledo, Ohio. Runner shown above and casing shown at right.

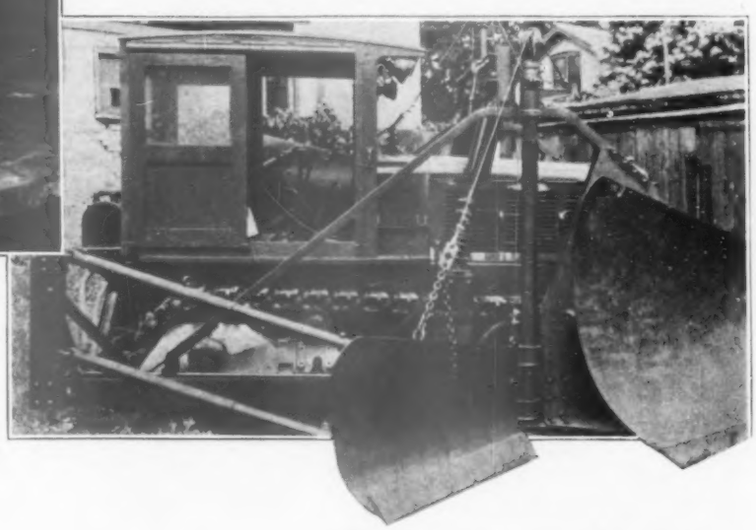
Next to salting away new customers safely in their bag, the Fausek brothers (A. J. and "Irv"), of the Modern Engineering Co., St. Louis, like nothing better than going gunning for fowl. Here is a recent day's "catch."





Hot-water heater, entirely arc welded, with a water capacity of 600 gallons. Tested at 300 lb. pressure. Designed for burning coal or oil. Built by the Sam Baird Welding Works, Ottawa, Ill.

The snow-plow season is here. This plow, built by the Otto Biefeld Co., Watertown, Wis., employs considerable welding in the construction of the blades and other parts.



From Left to Right: Four Hammer Heads to Be Finished, One Completed, and Three After Being Used a Year or Two.

Rebuilding Hammer Edges With the Oxyacetylene Torch

■ By E. D. SODERSTROM
Instructor, Oklahoma Agricultural & Mechanical College

THE question of buying new hammers or reworking old ones constantly crops out around a forging and welding shop. In the course of time, I have worked out a procedure that produces satisfactory results by building up the edges with the torch, then reforging, hardening and tempering. At the close of this article is described the method I am using for preventing "mushrooming" in top tools.

The photograph shows, to the left, four hammer heads to be refinished; in the middle, one as completed; and on the right three that have been in use from one to two years after refinishing. One of the interesting features of this project is that it contains most of the features essential to proper working of tool steel. I shall give the general procedure that I follow.

Procedure for Welding and Tempering

Grind out to the bottom of any cracks, and grind out spalled-off places so as to remove rust, bits of metal and dirt. Place the hammer in a slow fire and gradually preheat to a low red. Have a helper hold the hammer face up on the welding table and rotate it as welding proceeds. Use a tool-steel filler rod and a little borax flux. Weld "backward"—that is, start fusion on the hammer edge, then bring the rod down and swing the welding tip back so as to melt a little metal off the rod. The tip should be given an oscillating motion back and forth diagonally across the edge. This spreads the heat enough to insure fusion between the hammer metal and the filler metal.

The reasons for welding backward are: (1) The exhaust gases cover the molten puddle until the metal sets, avoiding the oxidizing and nitriding effects of the atmosphere. (2) The filler metal fuses directly into the hammer metal without agitation or overheating, thus meeting the conditions necessary to produce a homogeneous structure in steel welds. When the weld is finished, place the hammer back in the preheating furnace, heat to a uniform "red," and anneal it.

The hammer is now ready to be reforged. This is done in the usual manner by heating to nearly an orange heat. Then, using a heavy hammer, forge in the edges on the first heat, reheat and on the second heat forge the face flat. For convenience in handling the hammer during forging, I use eye-tongs, shown in the photograph. The hammer is now annealed. Next it is ground to shape.

The hammer is now ready for hardening and tempering. For this operation I use a fountain spray. The fountain consists of a vertical ¼-in. pipe connected to the city water supply, with a globe valve to control the flow. The fountain is of course set up over a tub, close to the furnace for convenience.

Heat the hammer up very slowly to a black red heat by placing it inside a piece of gas pipe bedded in a slow-burning forge fire. I allow about one-half hour for this step. The reason is that tool steel conducts heat rather slowly, and any attempt to heat it rapidly by placing it in a hot fire results in cracks more or less parallel to the edges. The edges being more exposed, heat up, and expand before the inside does, thus pulling away from the core. In some hardening departments it is a rule to allow an hour for each inch of thickness in heating steel for any operation.

After being preheated, the hammer is placed in a gas-fired furnace and brought up to the hardening heat. The heat can be easily maintained at the proper temperature in the gas furnace, making it better for the final hardening heat than a forge fire.

To harden, hold the hammer so the face is centered over the fountain spray, and let the water play against it until the edges remain wet. Now polish the face with an emery stick and place a small wet dab of asbestos in the center. Let the heat run back to draw the temper until a brownish purple color shows around the edges; meanwhile keep the small center dab of asbestos wet by squeezing a drop of water onto it with a bit of waste. The torch may be used to supply a little extra heat along the edges to even up the temper draw.

The ball end may be hardened by heating the end of it to hardening heat and plunging in slightly warm water; it needs no drawing. In the case of cross-peen hammers, the edges should be drawn to purple.

The reason for hardening a hammer this way is to produce a hard center and a somewhat softer and more elastic edge. This best meets the condition of impact to which a hammer is subject in use.

The plunging method of hardening only hardens the edges, while the center is left soft due to the steam cushion formed against the face while the exposed edges are quickly cooled. This produces a hammer that will "upset" and spread in the center, causing the edges to crack and spall.

Treatment for "Mushrooming"

Top fullers, top swages, set hammers, flatters—in fact, all tools that are struck with a sledge — are subject to "mush-

rooming." This means more or less danger due to flying pieces of steel, and there is the delay due to repair and overhauling. The method I employ to get around this constant redressing is to cut away all the old mushroom, then weld several "beads" of soft steel round the top, but leave the top exposed. So far I have always done this with the "coated" electrode and arc-welder. Next I reforge the head and harden the exposed steel end in the same manner as described above for hammers. This method leaves an elastic, soft steel band around the hard center. The life of the tools is increased several times and there is practically no danger from "mushroom" chips.

Cleveland Section Hears Talk by Chapman

"Welding of Heavy Machinery" was the subject of a talk by Everett Chapman, vice-president of Lukenweld, Inc., of Coatesville, Pa., at the last meeting of the Cleveland Section, American Welding Society, which was attended by approximately 150. Mr. Chapman brought out the necessity of proper design and stress-relieving, and mentioned a certain machine in which it was desirable to use three different kinds of metal for base material, each being selected for its particular qualities at the point used.

Shop Framework Built of Automobile Parts

By W. E. ARCHER

One way of making use of old autos is to wreck them and use the frames for building welding shops. At least this is the way W. A. Estes, Jr., of Los Angeles, Calif., utilized a job lot of old car frames recently in the building of a welding shop for his machine plant at 4017 Medford Drive.

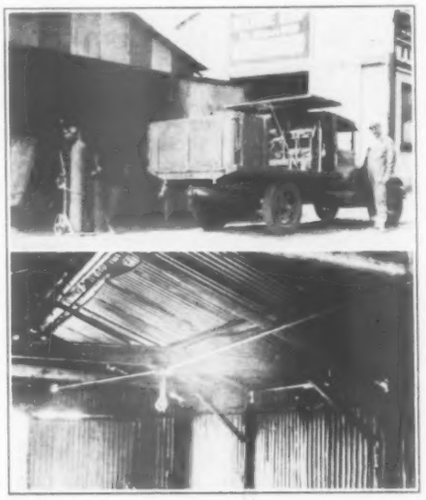
Two photographs of this oddly constructed shop accompany this article, one being an exterior view of a portion of the completed shop, and the other a view of the interior, showing the method employed in utilizing and assembling the old car frames in building the frame of the building.

The building is of all-welded construction, not a single bolt or rivet having been used. The frames were obtained from various sources such as at wrecking yards, the city dumps, etc. Cutting and fitting the steel from these frames to form the framework of the building was ingeniously done wtih an oxyacetylene cutting torch. The side and end upright members supporting the structure, and also the longitudinal members, or ribbons, supporting the roof, are all made of Chevrolet and T-Model Ford frames, while the truss members are of Buick and other similar heavier car frames.

This material, together with its welded construction, while not the most uniform and neatest in appearance, furnishes a completed building of unusual strength and durability. Frames from about 50 cars were used in its construction, and at a cost of less than 10 cents per frame, or a total cost of only about $5 for the entire framework of the shop.

The sides and roof of the building are covered with second-hand galvanized corrugated sheet metal at little or no cost, having been taken from an old building which was being razed following the recent California earthquake.

Short pieces of the car frames and other parts which were not used in the building were utilized in making welding tables, jigs, racks, benches, and the like



Exterior and Interior Views of Welded Job Shop.

for the shop, thus effecting further savings in material.

Mr. Estes, who is standing beside his truck in one of the photographs, also built the electric welding unit shown on the truck. The generator is driven by a rebuilt and rebored 1925 Hupp motor, and Mr. Estes says it performs very efficiently.

Aluminum Tank Cars to Be Welded

Four tank cars made of a special alloy of aluminum, with all seams oxyacetylene welded, has been ordered by the Carbide & Carbon Chemicals Corp. to haul acetic anhydride and other oxydized alcohols from the company's plant at South Charleston, W. Va., to rayon plants. The cars are being built in the General American Transportation Co.'s tank car shops at Sharon, Pa., and delivery will be made about Jan. 1st.

The cars, which will have a capacity of 8000 gallons each, will be built to conform with the requirements and specifications of the American Railway Association. Each tank will measure approximately 78 in. in diameter and 31 ft. 3¼ in. in length and will be equipped with eight lines of 2-in. extra-heavy aluminum seamless-tubing heater coils.

The first aluminum tank car was constructed by this company in the fall of 1928 for experimental purposes, and was fabricated by oxyacetylene welding. This car has been used since that date in various services and has given no trouble whatsoever from the welded joints. The new cars will contain many features not incorporated in the first car.

Now They're Welding Celluloid

The air-acetylene flame has been used to make satisfactory welds in celluloid, which is reported by A. Stephenson, in the *Journal* of the Royal Society of Arts (British), as an extraordinary example of the welding of inflammable materials.

Chicago Section Meeting on Structural Welding

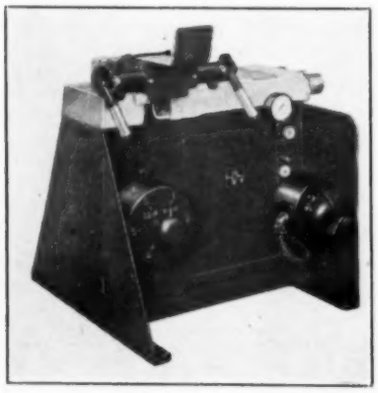
The meeting of the Chicago Section, American Welding Society, held at the Palmer House, Chicago, Dec. 15th, was given over to structural welding. Robert Hale, of The Structural Welding Co., reviewed briefly the progress thus far made in structural welding and the adoption of welding codes, and described a practical method of field testing involving the use of a hydraulic jack. Henry Penn, of the American Institute of Steel Construction, gave a critical analysis of certain arguments and demonstrations that have been promoted as showing advantages of welding over riveting, and pointed out the unreliability of these methods. Welding should be considered as a tool, said Mr. Penn, and welded construction should be promoted for its own sake rather than as an attempt to show up the shortcomings of riveting.

At the meeting of the Section held Nov. 24th in the Wedgewood Hotel, T. B. Marshall, of the Chicago headquarters of the NRA, gave an outline of the Administration's recovery program and the part played by the National Industrial Recovery Act. T. S. Wright, general manager of the Hollup Corp., prepared a paper on the status of the NEMA welding code and outlined its general provisions and how they will operate. Since Mr. Wright could not be present his paper was read by K. B. Mackenzie, secretary of the Section. K. L. Hansen, of the Harnischfeger Corp., Milwaukee, and several others entered into the discussion which followed Mr. Marshall's talk. The closing remarks of the chairman, Ernest Wanamaker, interspersed with homely wit and naive philosophy, was one of the high-lights of the evening.

New Equipment

Small Flash Welder for Precise Work

A new fully automatic precision-type flash welder with finger-tip control, permitting variable flashing speed and upset pressure, has been developed by the Micro Products Co., Peoria, Ill. In using this machine, known as the Model H Micro-Weld Motor-Driven Hydromatic Flashwelder, the operator merely clamps the stock, starts the machine, and removes the finished weld. This machine is



Maximum Dimension Is 29½ In.

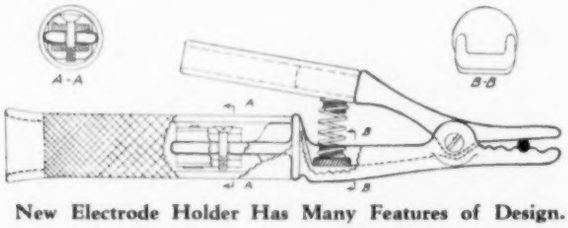
easily and rapidly adjusted for a variety of sizes of work, and is equally suitable for production work.

The hydraulic control is conveniently located for quick and accurate setting of valves that regulate the welding cycle. The electric control is entirely automatic during the welding cycle, and is so interlocked with the hydraulic unit as to eliminate the guess work, it is claimed. Precise control of operations is obtained, even when welding thin cross-sections.

This convenience of setup is especially valuable when the machine is being used on short jobs, since the variety of flashing speeds and upset pressures increases the scope of operation and simplifies change-over.

New Light-Weight Electrode Holder

An electrode holder made of a rust-proof bronze alloy, containing 92% copper, and weighing only 13½ ounces, has been developed by the Craftsweld Equipment Corp., 250 W. 54th St., New York, N. Y., and is known as their K-5 electrode holder. Other features of this holder are the one-piece conductor, from cable to electrode, cable connection with 2 sq. in. of contact, knurled and ventilated handle of vulcanized fiber, oil-tempered spring insulated against heat or accidental grounding, grooved jaws for gripping the electrode at various angles, and a maximum transverse clearance of only slightly over 2 in. This holder is said to be especially handy for overhead work or in tight corners. It can be furnished with or without a fiber guard.



New Electrode Holder Has Many Features of Design.

Acetylene Generator Fits Running Board

An acetylene generator being developed by George Robinson, Bradner, Ohio, is narrow enough that it can be carried on the running board of an automobile without protruding beyond the side of the car. It has a capacity of 20 lb. and is of the carbide-to-water type. It has ample capacity to provide a gallon of water to each pound of carbide. Instead of resting on the bottom of the tank, it is mounted on runners. In the shop, its narrow dimension allows it to be set close to the wall.

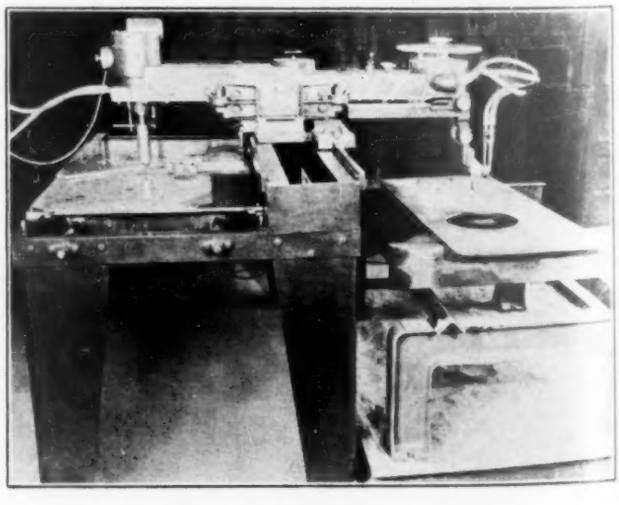
New Machine Torch for Precise Cutting

A new stationary cutting machine, known as the Pantosec, has been introduced by The Linde Air Products Co., 30 East 42nd St., New York, N. Y. This machine has a cutting range of 44 in. in one direction and 20 in. in the other, and will cut straight lines, angles, circles, and intricate shapes, with or without bevel. It is especially suitable for the precision cutting of dies, cams, and other parts requiring smooth, accurate cutting.

The carriage is mounted on three-point supports. The torch can be guided automatically or by hand. Templates can be used, or the cutting head can be locked for travel in a straight line.

Means for adjustment makes it possible for the cutting torch to be lined up without shifting the work, and a dividing head enables the operator to set stops on work that is to be cut in several directions. An extension, so mounted as to be steady and secure, makes it unnecessary for the operator to return to the back to start the profile cutting after the entry cut has been made.

"Pantosec" Cutting Machine



New Lincoln Electrode for Cast Iron

An electrode for welding cast iron by the shielded arc process is announced by The Lincoln Electric Co., Cleveland, Ohio. The electrode, known as "Ferroweld," not only simplifies welding procedure on cast iron but is said to produce a weld with greater strength and ductility than the cast iron itself.

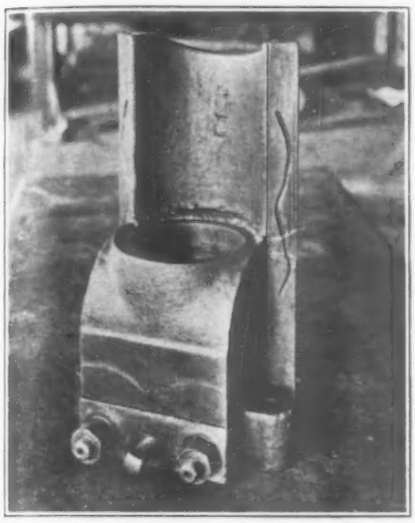
"Ferroweld" has a steel core surrounded by a heavy flux coating which protects the arc from gases injurious to the weld which are present in the atmosphere. One of the outstanding advantages claimed for "Ferroweld" is the remarkably low heat with which it can be used, thus reducing the possibility of cracking. The electrode is manufactured in the ⅛-in. size only and is used with approximately 80 amperes of current.

Welding is done intermittently, not over a 3-in. bead being laid down at one time. As each bead is welded it is peened lightly, thoroughly cleaned, and allowed to cool somewhat before the next bead is deposited. Due to the extremely low current used, the hardening effect ordinarily present along the line of fusion is materially reduced. Thus the weld is more machinable than most cast-iron welds.

The photographs show a weld made on a punch press ram with "Ferroweld." The ram is about 22 in. wide and approximately 1½ in. thick at the break. The press in which the ram is used is in constant use for punching holes as large as 7 in. in diameter in 10-gage steel. The ram was broken in operation at the point indicated by the chalk mark on the photographs.

In order to repair the ram the part was vee'd out, with a vee about 2 in. wide at the back, leaving approximately ⅛ in. of metal at the bottom of the vee. The part was then tack-welded at the inner ends of the chalk marks. Short beads were laid intermittently along the line of the break, first on one side of the ram and then on the other. The outside flanges of the ram which fit in the guides were ground down after welding. There were no signs of cracking or pulling away in the weld. No checks were present.

This ram has been in use for several weeks after welding and is operating as well as when new.



Front View of Ram After Being Repaired With "Ferroweld."

Same Job Viewed From the Rear.

New "Universal" 4-Wheel Trailer-Type Arc Welder, Equipped With Novel Idling Control.

Portable Arc Welders With Finger-Tip Control

"Universal" arc welders, utilizing the shunt-inductor principle of arc stabilization, are now available with 4-wheel portable trailer mounting, as well as the 2-wheel mounting announced some time ago.

In the gasoline-engine-driven unit, a novel idling control, instantly responsive to the will of the operator, permits the engine to run slowly when not welding, thus economizing on gasoline, lubricating oil, and engine life. When ready to weld, the operator at his electrode holder brings the equipment again to automatic governed speed and proceeds with his work.

The welding generator, with two dirt-free cartridge-enclosed ball bearings, is flexibly coupled to a rugged 6-cylinder engine and mounted on a rigid structural-steel chassis, with "donut" low-pressure balloon tires, giving a unit of low gravity and good roadability. This welder is made and sold by the Universal Power Corp., 1719 Clark Road, Cleveland, Ohio.

Trade Literature

"Hetzel—Fabricators of Steel Products" is the title of a catalog issued by The Heltzel Steel Form & Iron Co., Warren, Ohio, showing typical examples of the company's work, including machine bases, transmission cases, storage bins, tanks, steel pipe molds, concrete forms, pipe fittings, and many other huge pieces of equipment, a great deal of which is of welded construction. Tables of use to the engineer and designer are also given.

The "MetaLayeR" process for applying sprayed molten metal coatings is described in detail in Bulletin 1201, issued by the Metals Coating Co. of America, 495 North 3rd St., Philadelphia, Pa. Instructions are given for preparing the surface, spraying the metal, and polishing or grinding the metal coating where a finished surface is desired.

Welded wheels of various designs and for different purposes can be built of stampings welded to hubs, a variety of these being shown in Application Sheet No. 36, Series 2, entitled "Elements of Design—Wheels." Copies may be obtained from The Lincoln Electric Co., Dept. 236, Cleveland, Ohio.

"Elesco" bronzes is the subject of Bulletin B-1, issued by The Superheater Co., Bronze Foundry Division, East Chicago, Ind., and describing bronze castings, rough or finished, and the company's facilities for making these. These castings are furnished in standard bronzes, aluminum bronzes, or as a super-tensile manganese bronze.

"Arc-Welded Tier Buildings: Fixed End Connections, Beams to Columns" is the title of Plate 42, in Studies in Structural Arc Welding, issued serially by The Lincoln Electric Co., Cleveland, Ohio. Diagrams show correct designs and illustrate the proper use of column web plates.

Motor Mechanics Handbook No. 33, describing equipment for repairing and servicing motor vehicles, was recently published by the South Bend Lathe Works, 335 E. Madison St., South Bend, Ind.

Commercial News

Revere Copper Makes Scott Vice-President

C. D. Dallas, president of Revere Copper and Brass, Inc., has announced the appointment of Robert G. Scott as vice-president in charge of the Taunton-New Bedford Division with headquarters at Taunton, Mass.

Mr. Scott has been associated with Revere Copper and Brass since its inception in 1929 and was previously connected with the Rome Brass & Copper Co. and Baltimore Copper Mills, both of which are now part of Revere.

He has had a wide experience in the copper and brass fabricating industry. He comes from the executive offices of the company in New York City, where for the past year he has been doing special work of a sales engineering nature, contacting important industrial customers. Before this time he was superintendent of the Revere copper rolling mills at Baltimore, Md.

The Taunton-New Bedford Division operates mills in Taunton and New Bedford, Mass., and serves the New England area. It dates back to America's first copper-rolling mill at Canton, Mass., which was established by Paul Revere, famous Revolutionary patriot, in 1802.

Death Takes George Rose

George Rose, service man of the Chicago office of The Linde Air Products Co., died suddenly on Nov. 19th in Evansville, Ind. He was born in 1876 in New York City, and had been connected with The Oxweld Acetylene Co. and the Linde organization since 1912. His loss will leave a void spot in the hearts of his many friends, who were scattered from coast to coast.

Controlling Quality of Carbon Steels

Differences in steel quality have been encountered by all working with the metal, particularly the forger, heat-treater, and welder. Occasionally the steel, although of the chemical composition specified, will not respond to heat or mechanical treatments in the manner expected, nor possess the anticipated physical properties. These variations in behavior may be encountered in different heats or even in different parts of the same heat.

A system of controlling quality factors in open-hearth steel has been developed by the Carnegie Steel Co., Pittsburgh, and is described in a recent booklet of theirs. The purpose of this system is not only to meet the chemical specifications of the purchaser but also to control the grain size and other factors affecting the behavior of the steel during processing. The ultimate aim is to be able to supply the purchaser with steel which will produce consistent results when subjected to the same processing methods.

"Industrial Uses of Stainless Steel" was the title of a talk delivered before a meeting of the American Society of Mechanical Engineers at Cincinnati, Ohio, on Nov. 23rd, by C. C. Snyder, of the Central Alloy Division, Republic Steel Corp., Massillon, Ohio, in which the characteristics and properties of stainless steel were discussed and many applications described. The talk was illustrated with lantern slides.

The Universal Power Corp., Cleveland, Ohio, has appointed F. R. Faulk, 50 Penn Ave., Pittsburgh, Pa., as district sales representative, and the Welding Equipment & Supply Co., 2720 E. Grand Blvd., Detroit, Mich., as Detroit distributor for "Universal" arc welders, accessories, and electrodes. Thomas Butler, of the Detroit company, is widely known in welding and automotive circles in that territory.

An extensive addition is being built to the St. Louis steel-service plant of Joseph T. Ryerson & Son, Inc. The new building will greatly increase the facilities for storing and dispatching steel and allied products such as welding rod, and will also include modern offices equipped with an air-conditioning system.

Wooldridge Aluminum Welding Products is the name of a new firm at 195 Naubuc Ave., Glastonbury, Conn., which has taken over the business formerly conducted under the name Wooldridge & Larson. In addition to fluxes and wire for aluminum welding, a bronze welding flux has also been developed, according to an announcement by Richard J. Wooldridge, president.

E. N. Carlson, recently connected with the Corby Supply Co., and for many years previously with Joseph T. Ryerson & Son, Inc., has become associated with Guy H. Rumpf, Railway Exchange Building, St. Louis, Mo., who represents the Bryant Machinery & Engineering Co., of Chicago, in the distribution of arc welders and machine tools.

The Betz-Pierce Co., formerly of 2230 East 9th St., Cleveland, Ohio, have moved to 1283 East 53rd St. They are distributors of Page-Armco welding wire and are now adding structural shapes to their line of supplies.

W. J. Holliday & Co., of Indianapolis, Ind., has opened a welding department in their Hammond, Ind., office and will handle Hobart arc welders in the Hammond territory.

Joseph T. Ryerson & Son, Inc., of Boston, New York and Chicago, has purchased the stock and goodwill of Bacon & Co., iron and steel company of Boston, Mass.

In compliance with NRA codes, the Acetylene Products Co., Indianapolis, Ind., have added four men to their payroll, reports Scott Wade, general manager.

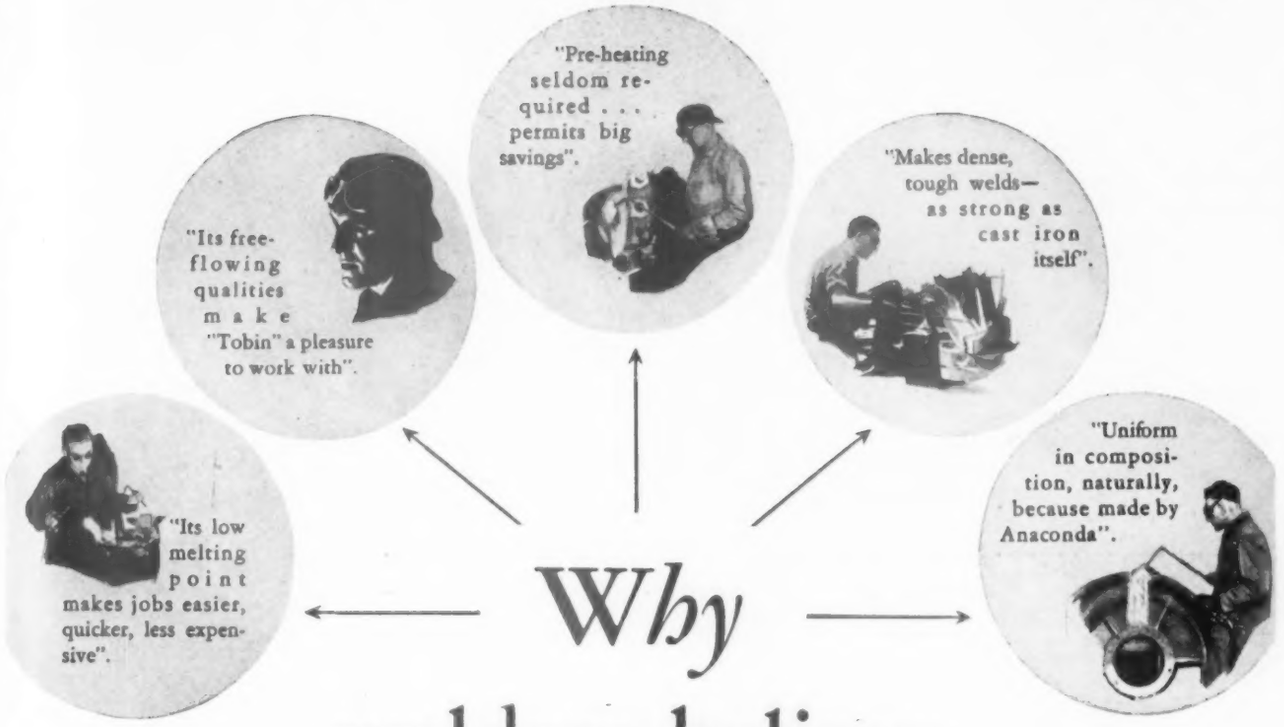
Carl Osterhous, formerly with The Indiana Oxygen Co., Indianapolis, Ind., is now traveling Indiana for the Sutton-Garten Co., of that city.

News From the Field

John Studzinski Passes Away

John Studzinski, of the State Welding Co., 25 John St., Hartford, Conn., passed away on Dec. 5th. He was a pioneer in the application of the gas-welding process and one of the first in the New England states to use arc welding extensively. His loss will be keenly felt by his many friends in the welding field. His wife, two daughters, and a son survive him.

It is reported from a reliable source that a large automobile manufacturer in the Detroit district is experimenting with an individual spring suspension for front automobile wheels which will eliminate the front axle entirely and will require much greater torsional rigidity on the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"Its free-flowing qualities make "Tobin" a pleasure to work with".
"Makes dense, tough welds— as strong as cast iron itself".
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"Uniform in composition, naturally, because made by Anaconda".

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Of the complete line of seven Anaconda Copper-alloy Rods, Tobin Bronze is the most generally used . . . because of its widespread acceptance as the ideal rod for the oxy-acetylene welding of cast iron and malleable iron. It melts at 1625°F; pre-heating is usually unnecessary.

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NRA

ANACONDA WELDING RODS

part of the frame. Welding is being used to obtain a frame of the required rigidity.

A customer recently brought a Chrysler cylinder head into Dunny's Welding Shop, at Youngstown, Ohio, to have it welded. The head was broken both on the top and the bottom. Whether the head could be welded did not seem to concern the customer so much as whether it would be true when finished. Mr. Donahue, the shop proprietor, assured him that it would be. The following day the customer returned to claim the head, and he carried under his arm a long straightedge to test the job for trueness. He evidenced much surprise when he found the job to be absolutely true. The skeptical customer who carries his own straightedge with him is still a rare being.

An interested visitor to the Purdue University Welding Conference, Dec. 7th and 8th, was Mathew Scioletich, an Austrian, graduate in civil engineering from Robert College, Istanbul, Turkey. While carrying on his college work, he spent three summers as a welder in the famous Stenia shipyards in Turkey. He is now taking graduate work in civil engineering at the University of Illinois and is making a special study of the application of welding to structural work.

Lewis A. Robertson and W. L. Woodward, both of Alva, Okla., who have been associated in the gas business since 1914, have acquired the gas properties of the Winchester Oil & Gas Co. and the Carlton Pipe Line Co. The franchise will be in the name of Zenith Gas System, Inc., which is the name of a new corporation organized by Messrs. Robertson and Woodward.

Blackstone, the famous magician, in a recent act in a Cleveland, Ohio, theater, was welded inside a steel cylinder on the stage before the audience, the welding being done by The Lincoln Electric Co. In view of the fact that the famous magician escaped, the reporter of this item wonders what rod and test the Lincoln company used.

Job welding shop owners in Toledo, Ohio, held a meeting on Nov. 13th for the purpose of forming an organization in accordance with the spirit of the National Industrial Recovery Act. Another meeting was held on Nov. 20th to continue the plans of organization. Both meetings were held at the Toledo Chamber of Commerce.

A 42-mile, 8-in. welded oil pipeline is under construction by Williams Brothers, pipeline welding contractors, of Tulsa, Okla. This line is being laid for the Stanolind Pipe Line Co. and will extend from the Lucien oil field in Noble County to a point near Drumright.

In order to comply with the requirements of their contract which calls for completion of the project by Jan. 1st, Bechtel-Kaiser Co., pipeline contractors of San Francisco, have awarded a subcontract to the Southwest Welding & Manufacturing Co., of Alhambra, Calif., for the welding and laying of 50 miles of the 10-in. gas line for the Western Gas Co., of Arizona. This line will extend from Tucson to Phoenix, Ariz. The A. O. Smith Corp., of Milwaukee, is furnishing welded pipe for this project. J. W. Lucas, of the Southwest Welding & Mfg. Co., is in charge of his company's part of the work on the line.

A bad accident occurred recently in the welding shop of F. L. Henry in Hynes, Calif. Elmer Rudolph, a welder, was attempting to repair a leak in a crude-oil truck-tank which had not been properly cleaned. The tank exploded, killing the welder, injurying several people, and wrecking nearby buildings. Fire followed, and the shop was a total loss.

Nat Cox, formerly a welder with a large trailer manufacturer, has opened a general welding and repair shop in Readstown, Wis. He has obtained from the Welding Engineering Co. of Milwaukee a rebuilt gas-engine-driven arc welder, direct connected, and mounted on a 2-wheel pneumatic-tired trailer.

Harry M. Lee and Fred Hamlet have opened a job welding shop in Nekoosa, Wis., and have enough work lined up to keep them busy for the next two months. They recently purchased a rebuilt 200-ampere portable motor-driven welder from the Welding Engineering Co., Milwaukee, Wis.

A $150,000 project which will employ a crew of welders throughout a major portion of the winter, is under way near Wichita Falls, Texas, by the Texas Company, which concern is constructing a 10,000,000-cu. ft. natural-gasoline plant. This is the first plant of its kind in Foard County.

The Inland Lime & Stone Co., Port Inland, Mich., crushers of limestone for open-hearth and blast-furnace fluxing, recently purchased a 300-ampere G-E arc welder of the WD type. D. R. Gunderman, formerly of Laona, Wis., has joined the company's welding department.

The St. Louis School of Airplane Welding has moved from 3410-12 Olive St. to 3410-18 Locust St., St. Louis, Mo. The general manager of the school is O. M. Carey, who has had many years of welding experience and was formerly an instructor in one of the U. S. Army aviation schools.

The Waitsburg Welding Works, Waitsburg, Wash., operated by Sprague & Smith, has completed and delivered to the grain cooperative at Milton, Ore., a 16,500-gallon gasoline tank of welded design. The tank is 27 ft. long, with a diameter of 10 ft. 3 in., and weighs 6½ tons.

The Northwest Engineering Works, Green Bay, Wis., have just purchased four more 400-ampere Hobart motor-driven welders, making a total of nine Hobart welders in this plant. The welding department of this company is very busy at this time.

The Eagle Iron & Welding Works, of 1702 S. San Pedro, Los Angeles, Calif., is being temporarily closed by its owner, George Harvath, who expects to reopen for business within a few months. Mr. Harvath has operated his shop at this location for the past five years.

The General Welding Products Co., Indianapolis, Ind., are making extensive alterations to their shop which will result in having separate quarters for their metal-spray department and boiler shop. Previously, these two activities were handled in one room.

The welding shops in central Michigan are organizing to stabilize prices, and so far the movement has been very effective, reports Mr. York, of the York Engineering & Supply Co., 1583 Clybourn Ave., Chicago, Ill., who recently visited that section.

A contract to recondition 200 frogs for the Boston & Maine Railroad has been let to the Teleweld Co., 80 E. Jackson Blvd., Chicago, Ill., it is reported. The repairs are to be made in the states of Massachusetts, New Hampshire and Maine.

The Mid-Continent Engineering Co., operating in the East Texas oil field, has been awarded a contract involving a large amount of welding in the construction of a 1,500-barrel oil-cracking unit at Kilgore, Texas, for the Southport Refining Co.

Paul Kash, of the Kash Machine Shop, Logansport, Ind., has completed an addition to his shop and is planning shortly to tear down the old section and replace it with the same type of modern structure as the new part.

H. W. Brock, formerly superintendent of the pressure-vessel shop of the A. O. Smith Corp. in Milwaukee, Wis., is now connected with the Cream City Boiler Co. of that city.

Joe El Franco and Robert Redondo, of Los Angeles, Calif., recently opened a

new welding shop at 1923 Brooklyn Ave., specializing in automotive welding and repair work.

The Coulter Boiler Machine Co., of Muncie, Ind., recently purchased a 300-ampere motor-driven Hobart arc welder from W. J. Holliday & Co., Indianapolis.

The Ashland Machine & Welding Co., Ashland, Ohio, have a contract to build six all-welded cooling towers for the Faultless Rubber Co., of Ashland.

The Milwaukee Railway & Light Co., of Milwaukee, Wis., recently purchased a new 300-ampere Hansen arc welder for their Lakeside power plant.

The Crawfordsville Radiator & Welding Shop, Crawfordsville, Ind., have moved into larger quarters next door to their old location at 208 Lafayette Ave.

The farmers' cooperative oil depot at McMinnville, Ore., has purchased two 20,000-gallon welded tanks from the Portland Tank & Steel Co.

The Doyle Radiator & Welding Shop has been opened in Crawfordsville, Ind., at 105 E. Market St., under the management of L. C. Doyle.

Morrison Bros., Dubuque, Iowa, are now manufacturing grave vaults of welded construction from Keystone copper-bearing steel plates.

Michum & Schoefer, 416 S. Pennsylvania Ave., Indianapolis, Ind., have installed a 200-ampere Hobart motor-driven arc welder.

The John J. Hill Co., Rochester, Ind., recently added a new Smith cutting torch purchased from the J. W. Holliday Co. of Indianapolis.

Joe Lane, of Los Angeles, Calif., has moved his automotive welding and repair shop from 2717 Central Ave. to 1140 East 42nd St.

The Winona Co., Winona, Minn., is manufacturing a hand-operated beer pump known as the "Dependon" beer pump.

The Diamond Boiler Co., Ellwood, Ind., have purchased a 200-ampere Hobart motor-driven arc welder.

The Superior Welding Co., Kokomo, Ind., have added a 200-ampere USL arc welder.

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Estimator and Supervisor—8 years' experience on boiler welding, automotive welding, and all kinds of commercial welding. Can manage a shop. Will go anywhere. M. W. Donarski, 2035 Armitage Ave., Chicago, Ill.

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A new book for the student of oxy-acetylene welding. It is written as a series of twenty lessons beginning with the fundamentals of the process. It explains the apparatus fully and shows how to set it up correctly. A job sheet at the end of each lesson gives an exercise to be performed dealing with the lesson studied and a series of questions to answer so that the student can test his knowledge of the material covered.

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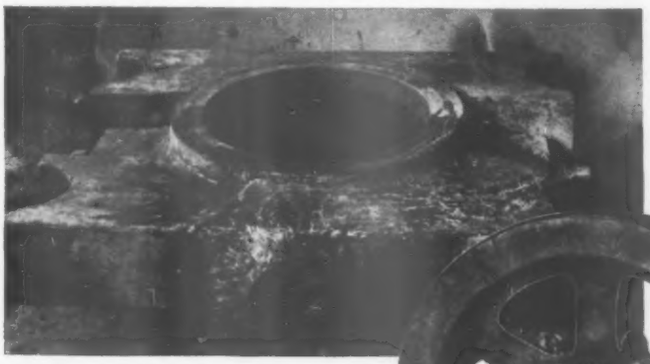

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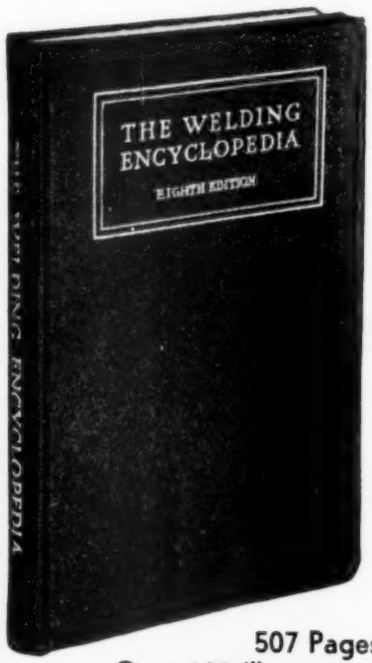

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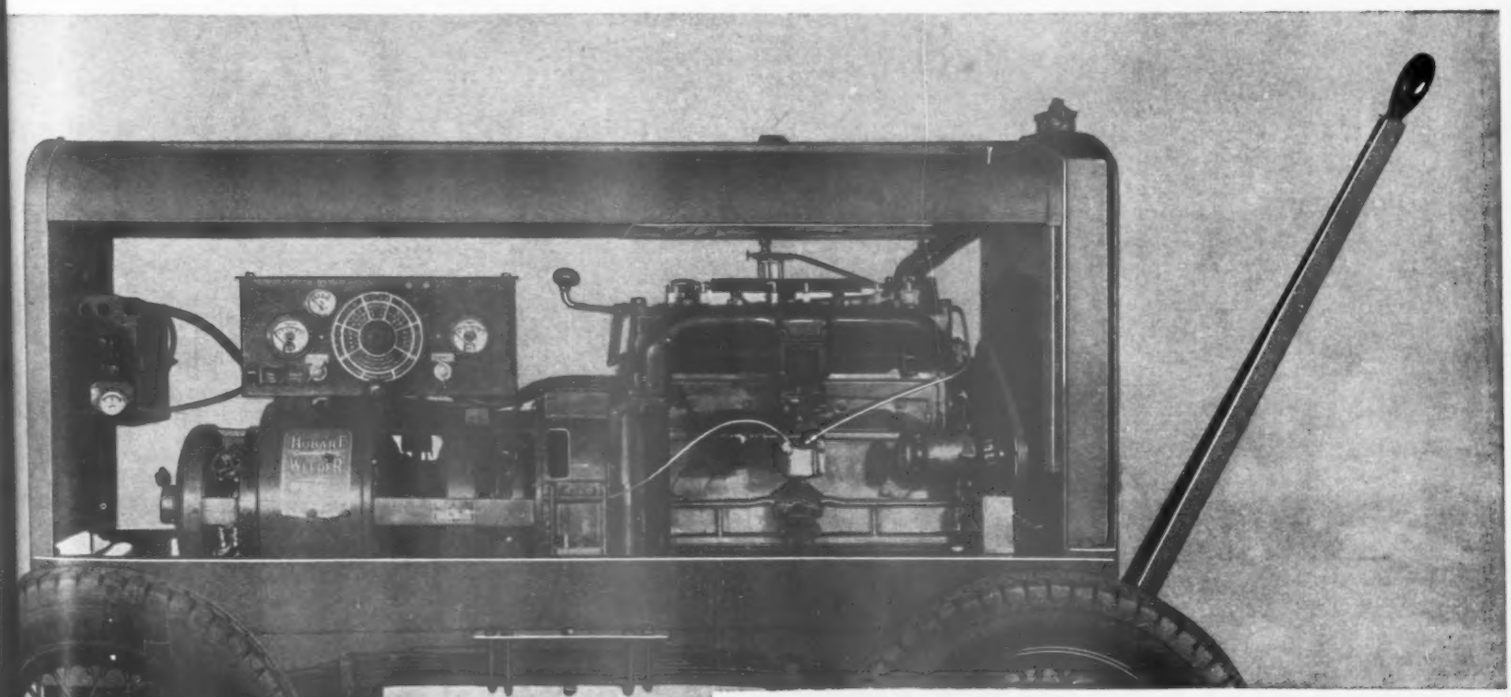

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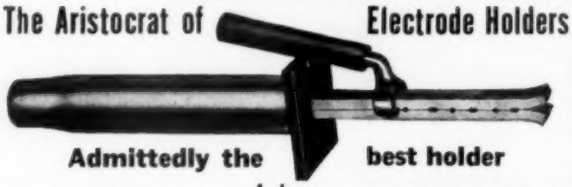

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Submitted by Neil S. Miller, Harrisburg, Pa.

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